

BUREAU OF FISHERIES

REPORT

OF THE

UNITED STATES
COMMISSIONER OF FISHERIES

FOR THE FISCAL YEAR 1921

WITH

APPENDIXES

HUGH M. SMITH

Commissioner



WASHINGTON
GOVERNMENT PRINTING OFFICE

1922

CONTENTS.

- REPORT OF THE COMMISSIONER OF FISHERIES FOR THE FISCAL YEAR ENDED JUNE 30, 1921. By Hugh M. Smith. 50 pp. (Document No. 900. Issued December 14, 1921.)
- PACIFIC SALMON FISHERIES. Third edition. By John N. Cobb. Appendix I, 268 pp., 48 figs. (Document No. 902. Issued May 24, 1921.)
- IMPROVEMENTS IN PROCESS OF SALTING RIVER HERRING, ESPECIALLY ADAPTED TO WARM CLIMATES. By Harden F. Taylor. Appendix II, 7 pp. (Document No. 903. Issued May 7, 1921.)
- FISHES OF THE YELLOWSTONE NATIONAL PARK. WITH DESCRIPTION OF THE PARK WATERS AND NOTES ON FISHING. By Hugh M. Smith and William C. Kendall. Appendix III, 30 pp., 16 figs. (Document No. 904. Issued December 31, 1921.)
- FOOD OF YOUNG WINTER FLOUNDERS. By Edwin Linton. Appendix IV, 14 pp. (Document No. 907. Issued July 23, 1921.)
- FISHERY INDUSTRIES OF THE UNITED STATES. REPORT OF THE DIVISION OF STATISTICS AND METHODS OF THE FISHERIES FOR 1920. By Lewis Radcliffe. Appendix V, 187 pp., 8 figs. (Document No. 908. Issued October 4, 1921.)
- ALASKA FISHERY AND FUR-SEAL INDUSTRIES IN 1920. By Ward T. Bower. Appendix VI, 154 pp., 3 figs. (Document No. 909. Issued December 12, 1921.)
- DANGER TO FISHERIES FROM OIL AND TAR POLLUTION OF WATERS. By J. S. Gutsell. Appendix VII, 10 pp. (Document No. 910. Issued October 3, 1921.)
- PROGRESS IN BIOLOGICAL INQUIRIES, 1921. REPORT OF THE DIVISION OF SCIENTIFIC INQUIRY FOR THE FISCAL YEAR 1921. By R. E. Coker. Appendix VIII, 38 pp., 2 figs. (Document No. 911. Issued January 26, 1922.)
- PROPAGATION AND DISTRIBUTION OF FOOD FISHES, 1921. REPORT OF THE DIVISION OF FISH CULTURE FOR THE FISCAL YEAR 1921. By Glen C. Leach. Appendix IX, 94 pp., 5 figs. (Document No. 912. Issued September 28, 1922.)

CONTENTS

| | |
|---|----|
| REPORT OF THE COMMISSIONER OF FORESTRY FOR THE FISCAL YEAR ENDING JUNE 30, 1921. BY HUGH M. SMITH. 50 pp. (Document No. 606. Issued December 14, 1921.) | 13 |
| FOREIGN ELMIGRATION FROM THE UNITED STATES. BY JOHN A. COLE. Appendix I, 202 pp. 12 pp. (Document No. 605. Issued May 14, 1921.) | |
| IMPROVEMENTS IN METHODS OF RAISING WATER RESOURCES. INTERNATIONAL AGREEMENTS IN WATER RESOURCES. BY HENRY M. TAYLOR. Appendix II, 7 pp. (Document No. 604. Issued May 14, 1921.) | |
| PLANTS OF THE YELLOWSTONE NATIONAL PARK. WITH DESCRIPTIONS OF THE PARK WATERS AND NOTES ON TIMBER. BY HUGH M. SMITH AND WILLIAM F. KENNEDY. Appendix III, 30 pp., 10 pp. 10 pp. (Document No. 603. Issued December 21, 1921.) | |
| FOOD OF FISHES OF THE UNITED STATES. BY EDWARD L. HENRY. Appendix IV, 11 pp. (Document No. 602. Issued July 23, 1921.) | |
| FOREIGN EXPORTS OF THE UNITED STATES. REPORT ON THE BUSINESS OF EXPORTS AND IMPORTS OF THE UNITED STATES FOR 1920. BY JAMES H. HARRIS. Appendix V, 10 pp. 8 pp. (Document No. 601. Issued December 1, 1921.) | |
| ALASKA: HISTORY AND GEOGRAPHY. BY JOHN T. HENRY. Appendix VI, 10 pp. 8 pp. (Document No. 600. Issued December 12, 1921.) | |
| REPORT ON THE BUSINESS OF EXPORTS AND IMPORTS OF THE UNITED STATES FOR 1920. BY J. S. HARRIS. Appendix VII, 10 pp. (Document No. 599. Issued October 1, 1921.) | |
| FOREIGN ELMIGRATION FROM THE UNITED STATES. BY JOHN A. COLE. Appendix VIII, 202 pp. 12 pp. (Document No. 598. Issued May 14, 1921.) | |
| FOREIGN ELMIGRATION FROM THE UNITED STATES. BY JOHN A. COLE. Appendix IX, 202 pp. 12 pp. (Document No. 597. Issued May 14, 1921.) | |

ERRATA.

APPENDIX IV.—Page 6, 3d line from bottom: 33.9 should read 32.9.

Page 8, 5th line under *Station 17*: 56 should read 51.

APPENDIX V.—Pages 151 and 152: Superior reference figures should be changed as follows—under *Washington*, 1 in first line of figures should read 2, and 2 following *Canned sardines* should read 1; in footnotes, 1 should read 2 and 2 should read 1.

APPENDIX VI.—Page 93, 3d line from bottom: 3 should read 2.

APPENDIX VIII.—Page 16, 9th line under *Pacific herring*: after *in* insert *January and February and off Baranoff Island in*.

**REPORT OF THE
UNITED STATES COMMISSIONER OF FISHERIES
FOR THE FISCAL YEAR ENDED
JUNE 30, 1921**

BUREAU OF FISHERIES.

HEADQUARTERS STAFF, 1920-21.

Commissioner,

HUGH M. SMITH.

Deputy Commissioner.—H. F. MOORE.

Assistants in Charge of Divisions:

Office.—IRVING H. DUNLAP.

Fish Culture.—GLEN C. LEACH.

Inquiry Respecting Food Fishes.—ROBERT E. COKER.

Fishery Industries.—LEWIS RADCLIFFE.

Alaska Service.—WARD T. BOWER.

Architect and Engineer.—GEORGE A. SCHNEIDER.

Accountant.—CHARLES W. SCUDDER.

Superintendent Central Station and Aquaria.—L. G. HARRON.

Bureau of Fisheries Document **1** *No. 900.*

CONTENTS.

| | Page. |
|--|-------|
| Inquiry respecting food fishes and fishing grounds..... | 5 |
| Importance of the service..... | 5 |
| Studies of fishes..... | 6 |
| Mosquito control by the use of fish..... | 7 |
| Fish-cultural experiment work..... | 7 |
| Surveys of particular waters..... | 9 |
| Aid to the shellfish industries..... | 9 |
| New sources of seaweed gelatin..... | 10 |
| Activities of the biological laboratories..... | 10 |
| Propagation and distribution of food fishes..... | 11 |
| Outline of the work..... | 11 |
| Distribution of fish..... | 12 |
| Relations with the States in fish culture..... | 13 |
| Cooperation with fish-protective associations..... | 15 |
| Hatching of river fishes of the Atlantic seaboard..... | 15 |
| Propagation of commercial fishes of the Great Lakes..... | 16 |
| Propagation of the Pacific salmon..... | 17 |
| Cultivation of fishes of interior lakes and streams..... | 18 |
| Hatching of marine fishes..... | 20 |
| Rescue operations in Mississippi Valley..... | 21 |
| Distribution of mosquito-eating fishes..... | 22 |
| Artificial propagation of fresh-water mussels..... | 22 |
| Relations with the fishery industries..... | 23 |
| Summary of conditions and activities..... | 23 |
| Fishery intelligence service..... | 25 |
| Studies of fishery methods..... | 25 |
| Improvement in handling fresh fish..... | 26 |
| Fish-marketing survey..... | 26 |
| Increasing the consumption of fish..... | 27 |
| Technological investigation..... | 27 |
| Increasing the use of by-products of the fisheries..... | 28 |
| Fishery conferences..... | 29 |
| New England vessel fisheries..... | 30 |
| Vessel fisheries at Seattle, Wash..... | 32 |
| Shad fishery of the Hudson River..... | 33 |
| Shad and alewife fisheries of the Potomac River..... | 33 |
| The frozen-fish trade..... | 34 |
| Fisheries of the South Atlantic States..... | 34 |
| Fisheries of the New England States..... | 35 |
| Sardine industry of Maine..... | 35 |
| Florida sponge fishery..... | 36 |
| Increased usefulness to the fisheries..... | 36 |
| Alaska fisheries service..... | 37 |
| Extent of the Alaska fisheries..... | 37 |
| Enforcement of fishery laws and regulations..... | 38 |
| Private salmon hatcheries..... | 39 |
| New salmon fishery regulations..... | 39 |
| Protection of walrus and sea lion..... | 41 |
| New legislation needed..... | 41 |
| Future development of Alaska fisheries..... | 42 |
| Control over the Alaska fisheries..... | 42 |

| | Page. |
|---|--------------|
| Alaska fur-seal service..... | 43 |
| General activities at the Pribilof Islands..... | 43 |
| The seal herd..... | 44 |
| The take of sealskins..... | 45 |
| Sale of sealskins..... | 45 |
| Foxes and reindeer..... | 46 |
| Miscellaneous | 46 |
| Semicentennial of the Bureau..... | 46 |
| New buildings and improvements..... | 47 |
| Vessel service | 48 |
| Appropriations..... | 50 |

REPORT OF THE COMMISSIONER OF FISHERIES.

DEPARTMENT OF COMMERCE,
BUREAU OF FISHERIES,
Washington, September 15, 1921.

SIR: I have the honor to present herewith a report giving a résumé of the operations of the Bureau of Fisheries during the fiscal year ending June 30, 1921. The major captions under which the activities are considered are inquiry respecting food fishes and fishing grounds, propagation and distribution of food fishes, artificial propagation of fresh-water mussels, relations with the fishery industries, Alaska fisheries service, Alaska fur-seal service, and miscellaneous administrative functions.

INQUIRY RESPECTING FOOD FISHES AND FISHING GROUNDS.

IMPORTANCE OF THE SERVICE.

The resources of the fresh and salt waters of the United States constitute great national assets as the means of livelihood of large numbers of people, as the basis of important industries, and as a conspicuous source of food. It is toward the manifold problems relating to the perpetuation of the supply of raw materials that the activities of the Bureau in biological investigation and experimentation are chiefly directed. It would be a shortsighted National or State policy that allowed the fishery resources to decline indefinitely or that failed to lay the basis of definite and exact knowledge necessary for their maintenance and increase.

Notwithstanding the importance of this matter, the Bureau's activities in this field have been seriously restricted, and at times altogether suspended in certain lines, by the low and inflexible salary scale which prevents the maintenance of a full staff of trained investigators. Under existing conditions some positions can not be filled, while in others assistants are retained for only brief periods. A further handicap is that promotions necessary to retain the services of a competent employee can often be made only by a transfer and change of duty from a field in which the employee has acquired skill to another in which he must have further experience before he can be expected to render service in proportion to his general ability. These and other disadvantageous conditions can readily be remedied by congressional action allowing the Secretary of Com-

merce to arrange salaries, within reasonable limits, with reference to the efficiency of employees rather than to the titles of positions. The entire subject of salary readjustment has been thoroughly studied in connection with the reclassification of Government employees, and a comprehensive and adequate salary schedule has been worked out by various competent agencies. It is hoped that all the time and thought devoted to the rectification of a chronic defect in the civil service may not terminate in mere discussion.

STUDIES OF FISHES.

General investigation of the life history of the chinook salmon, special studies of the salmons of Alaska, and an inquiry into the injurious practice of taking immature salmon by trolling and seining off the mouths of Pacific rivers have been continued. It has been determined in the last-named investigation that in the early part of the season nearly three-fourths of the salmon taken are immature, although later these fish constitute only a small proportion of the total catch. Relatively few immature salmon are taken at the mouth of the Columbia River, but a very considerable percentage of the chinook salmon obtained by trolling in Monterey Bay are not prospective spawners of the year. The facts ascertained obviously call for appropriate regulatory measures, for the killing of immature salmon is both economically and biologically wasteful. In the evident belief that the matter can not be fully handled by the several States, the United States Senate has passed a resolution requesting the President to negotiate such treaty or treaties as may be needed to secure to the salmon of the Pacific Ocean off the coasts of the United States and Canada protection from unnecessary destruction through wasteful practices, devices, and methods of capture. During the 1920 season there were taken on their return to the Columbia River a number of salmon that had been marked at the time of their planting several years previously. Although the number of marked fish recovered was limited, their study has afforded a basis for inferences on both the natural history of the salmon and the value of fish-cultural practices.

The study of the whitefishes and their relatives of the Great Lakes, which had previously been conducted on Lake Huron, was extended to Lakes Michigan and Ontario, and substantial progress was made. As soon as the necessary field work in other lakes can be completed a report of the results will be given out. The investigation takes account of species, distribution, places and seasons of propagation, life histories, and food. The results are expected to afford a proper basis for regulatory measures and guidance in artificial propagation and may therefore be a means of bringing about a restoration of the former abundance of these important fishes.

Considerable attention has been devoted to the food and distribution of fishes in interior lakes, the inquiries being intended not only to afford guidance in regard to the stocking of waters, but also to reveal the character of shores and border waters which should be preserved or maintained in order to promote the productiveness of lakes in food supply. It has not been possible to give the river systems the study which is evidently required if the continual decline

of important commercial and game fishes is to be checked, but the Bureau has, nevertheless, availed itself of the opportunities occurring to study extensively the conditions prevailing in certain portions of the Mississippi River and to direct a special inquiry into the natural history and propagation of the paddlefish.

Coincidentally with the prosecution and development of the marine fisheries there is required a full understanding of the life histories and migrations of the fishes involved and of the conditions of their reproduction and growth. The Bureau has been attempting to supply the necessary data, and to this end has been conducting special surveys of waters and special studies of individual fishes and groups of fishes and has accumulated much valuable material. During the year there was completed a report bringing together what was previously known and what has recently been learned of the natural history of the fishes of one of the most important commercial families, and there has been begun a compilation of the results of many years of collection and study of material bearing on the life histories and habits of the food fishes of the North Atlantic.

Announcement is made of the completion of the study of the fishes of Panama as the Bureau's cooperative part in the Smithsonian Biological Survey of the Panama Canal Zone. The survey was undertaken several years ago to lay a basis for comparison of conditions prevailing before and after the completion of the canal connecting the two oceans. The necessity of keeping the staff of the Bureau occupied upon problems of immediate importance has delayed the completion of the study of the fishes until during the past fiscal year.

MOSQUITO CONTROL BY THE USE OF FISH.

The cooperation of the Bureau of Fisheries having again been sought by the United States Public Health Service in the anti-malaria campaign in southern States, an assistant was detailed, as last year, to give counsel and assistance to Federal, State, and local health officials concerning the use of fish for the control of mosquitoes. The value of this service is attested both by the statements of health officers as to the results gained and economies effected and by the report of the Surgeon General of the Public Health Service. Investigations have been continued to gain additional information as to the conditions of the most effective use of fish for destruction of mosquitoes both in southern waters, where the prevention of malaria is a primary object, and in northern waters, where mosquitoes have a recognized deleterious effect upon the efficiency of labor and upon property values. As a result of the inquiries conducted in the north the Bureau has been able to give helpful advice to various municipalities and individuals.

FISH-CULTURAL EXPERIMENT WORK.

While national attention is directed to the important object of promoting the productivity of lands, we generally take what the waters produce as a gift of nature, something to be exploited and perhaps protected, but not to be cultivated. As the culture of plants and ani-

mals of the land can be made responsive to the application of scientific principles and experimentation, so the culture of the products of the ponds, lakes, and rivers may be increased by discovering the favorable and the limiting factors of production. The necessary investigative work involves careful studies of conditions characteristic of rich and poor waters, observations of the relations existing between fish and the other animals and plants with which they are associated, and experimental work to test the effect of particular factors upon the growth and multiplication of fish.

While scant special provision has been made for strictly fish-cultural experiment work, the Bureau endeavors to take advantage of such opportunities as are offered for work of this character, and these are found principally at the fisheries biological station at Fairport, Iowa. Experiments are conducted at that station to appraise the capacity of small ponds to support fish life, to determine the best plans of pond management, to discover what species of aquatic plants or animals should be introduced or fostered in fish ponds, and to make fish-cultural methods applicable to species of fish not hitherto propagated by artificial methods. Some experiments have also been conducted in connection with fish-cultural stations to discover means of reducing losses of eggs, fry, and brood stock, and of preventing deterioration of fertility of brood stock. If adequate and permanent provision could be made for the facilities and personnel of experimental work of this nature, the interests of economy would be served in the long run by increasing efficiency in all fish-cultural operations affected. One of the results incidentally obtained at the Fairport station—the devising of a new form of pond outlet which has stood the test of several years' trial—has shown the possibility of effecting substantial economies in the construction and maintenance of ponds at all stations where earth ponds are used.

Another means of effecting permanent economies in fish-cultural operations can be found in the reduction of disease or other causes of mortality in hatcheries. To serve this purpose, the primary necessity is a competent and permanent employee for the study of fish diseases. The need was recognized by Congress when in 1915 it established the position of fish pathologist as a part of the regular scientific personnel of the Bureau. During the six years which have elapsed since the position was created it has been vacant for one-third of the time and during the remainder has been held by three incumbents, none remaining in the service long enough to make more than an encouraging beginning. The difficulty has been that the salary was inflexible and fixed at too low a rate to attract and hold the proper man. The remedy is easily found in a readjustment of salary conditions such as has been referred to in a preceding paragraph. The position of fish pathologist was occupied during half of the past fiscal year, and investigations were directed at the ovarian diseases of fishes and the high mortality rate prevalent in all pike-perch hatcheries. Utilizing the services of temporary investigators, the Bureau has also made investigations of the losses of fish rescued in warm weather, finding a practicable remedy, and studies of injurious parasites of fishes.

SURVEYS OF PARTICULAR WATERS.

For the proper conservation of fishery resources and for gauging the necessity for and results of fish-cultural work it is important to have the most complete knowledge of the natural conditions in waters where fish propagate, grow, appear, and disappear under the control of factors now but little understood. During the past year such general investigations and surveys have been conducted both in the North Atlantic Ocean and in Chesapeake Bay—two of the most important sources of fish food and the locations of some of our principal fisheries. A comprehensive report embodying the results of observations gathered during a number of preceding years in the Gulf of Maine is now in preparation, special consideration being given to the life histories of the useful fishes and the conditions governing their distribution. In Chesapeake Bay the field work of the general survey has been completed, and it remains to compile and report upon the large mass of data accumulated. The special field studies of the occurrence and distribution of fish in the bay and tributary waters is being actively prosecuted. Other studies of a general nature have been conducted at relatively small expense in certain interior lakes, in cooperation with the Wisconsin Geological and Natural History Survey, and in the Mississippi River as a part of the work of the biological station at Fairport.

An event of interest and promise was the formation during the year of an international committee on marine fishery investigations composed of three representatives from Canada, one from Newfoundland, and three from the United States. The function of this committee is not to engage in joint work, but to serve as a ready means of effecting interchange of counsel, coordination of plans, and harmony in methods of marine investigations.

AID TO THE SHELLFISH INDUSTRIES.

The Bureau is rendering every practicable service to the oyster growers in the difficult circumstances which confront them in certain regions because of the failure of natural seeding. The conditions during the season of 1920 were very unfavorable to experimentation, and the work was further hampered by the loss in course of the season of the assistant charged with major responsibility for the investigations. The natural conditions in the beginning of the season of 1921 seemed favorable for experimental work, and the Bureau was able, as the results of the methods of study worked out and followed during preceding years, to render direct service to planters in the waters where investigations were being conducted. Progress has been made in the investigations to determine the effect of pollutions upon oyster propagation, both through direct action on the larvæ and through impairment of the vitality of oyster larvæ or of the fertility of breeding oysters by exhaustion of oxygen supply in the water.

Investigations of previous years had opened the way for artificial propagation on a commercial scale of fresh-water mussels, on which a very important button industry depends. The nature and extent

of this work in the past fiscal year are elsewhere shown. Further and practically continuous efforts will be necessary in order to supply deficiencies in existing knowledge and to determine the effects of fishing operations and regulatory measures on the mussel resources of particular water areas. During the year there were distinct advances in experimentation, artificial propagation, and protection. An experiment in recovering young mussels dropped from infected fish retained in an inclosure gave a proportionate yield much greater than had been assumed to be necessary to justify the expenditures for artificial propagation. Protection is, of course, a function of the several States, but the Bureau has done much to stimulate interest in the matter, and almost invariably the counsel of representatives of the Bureau is sought by the States in determining the portions of rivers to be closed against shelling operations for the protection of mussels.

NEW SOURCES OF SEAWEED GELATIN.

The investigation of gelatin derivable from seaweed was extended during the year to certain species of red algæ of the Pacific coast, with the result that a new source of agar-agar of superior quality was disclosed.

Agar-agar is the commercial name applied to a gelatinous product of certain red algæ which is imported from Japan, China, and other places. The importations in 1919 amounted to nearly a half million dollars. Agar is used in making foods and confections, but its principal importance arises from the fact that it is a necessary medium for bacteriological work and is, therefore, essential to medical laboratories and hospitals. Four species of algæ from the Pacific coast were the subject of experimentation, and agar prepared from one of these tested at the Army Medical School in Washington was pronounced equal or superior to the imported agar, while another species yielded a product apparently of like quality.

The discovery of domestic raw materials from which this important peculiar product may be made is a noteworthy event. In order that both Government and private interests may hereafter be independent of foreign sources of supply, further investigations should be conducted to determine the availability and locations of the proper algæ on our coasts as well as the suitability of other species than those used in the experiments already made.

ACTIVITIES OF THE BIOLOGICAL LABORATORIES.

The situation with regard to the marine biological laboratories remains distinctly unsatisfactory. The anomalous salary conditions make it hopeless to secure and retain a competent scientific staff, and the positions are generally vacant. While the stations at Beaufort, N. C., and Key West, Fla., have been virtually nonproductive during the past year, it has nevertheless been necessary to incur expenditures for maintaining the property. It has not, however, been practicable to prevent deterioration of the properties without more drastic curtailment of activities in other directions than seemed consistent with the accomplishment of a reasonable measure of public

service. The Woods Hole (Mass.) laboratory was in operation with a small scientific staff in the summer of 1920, but it was impracticable to reopen it in the summer of 1921.

In the last annual report (pp. 22 and 62) reference was made to the new building nearing completion at the Fairport (Iowa) station. The building was occupied in August, 1920, and has been found excellently suited for the purposes of fishery investigations. On two occasions during the year it was the scene of conferences of national scope for consideration of questions affecting the conservation of resources of interior waters and the application of scientific studies to that end. Both conferences, but particularly the one held June 8-10, 1921, brought together persons of varied interests from many States and were most helpful in affecting interchange of ideas and promoting harmonious action to the end that more care may be taken to insure the permanency of fishery resources.

PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

OUTLINE OF THE WORK.

The fish-cultural activities of the Bureau are directed to the maintenance of the existing aquatic resources of the country and the development of new sources of supply by the stocking of barren waters and the introduction of useful species into waters to which they were not indigenous. In this work the Federal Government operates along the same lines and with the same object as do many of the States. Five distinct functions are involved in this service, namely, the collection and fertilization of the eggs of food fishes, the incubation of the eggs in hatcheries, the feeding and rearing of the young of certain species, the distribution of fishes (and, in some cases, eggs) for planting in suitable waters, and the rescue of fishes from landlocked flood waters of the Mississippi Valley.

The principal source of the fish eggs handled by the Bureau continues to be the commercial fisheries, in which vast numbers of eggs that would otherwise be sent to market in the fish and be a total loss are obtained for hatching purposes by experienced spawn takers. In the case of some important fishes, notably, but not exclusively, the salmons of the Pacific coast, where commercial fishing does not extend to or is not permitted in the spawning areas, the ripe fish are caught in seines or traps and their eggs are removed, the object being to bring about a higher percentage of fertilization than is possible under natural conditions and to afford to eggs and resulting young protection from enemies and physical fatalities during and immediately after the hatching period. Eggs in noteworthy numbers are obtained also from domesticated fish held from year to year in ponds at the stations.

No material increase in the scope and magnitude of the fish-cultural work was possible during the year. With the available operating funds remaining the same, the most careful scrutiny of expenditures and the closest application of employees to their duties have been required to maintain the service at its existing standard of efficiency.

The fish-cultural operations in 1921 were conducted in 33 States, Alaska, and the District of Columbia, and the output reached every

State and Territory. The number of fingerlings handled was 226,589,545, fry aggregated 3,626,262,730, and the fertilized eggs assigned to State hatcheries or planted on the natural spawning grounds of the respective species numbered 1,109,637,130. The following table gives a summary of the output of each species:

SUMMARY, BY SPECIES, OF THE OUTPUT OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1921.

| Species. | Eggs. | Fry. | Fingerlings. | Total. |
|-----------------------------|---------------|---------------|--------------|---------------|
| Catfish..... | | | 35,257,070 | 35,257,070 |
| Carp..... | | 106,043,000 | 3,918,580 | 109,961,580 |
| Buffalofish..... | | 108,307,000 | 1,645,835 | 109,952,835 |
| Shad..... | | 32,792,275 | | 32,792,275 |
| Alewife..... | | 43,815,000 | | 43,815,000 |
| Whitefish..... | 181,650,000 | 238,800,000 | | 420,450,000 |
| Cisco..... | 186,510,000 | 89,800,000 | | 276,310,000 |
| Silver salmon..... | | 600,000 | 6,486,150 | 7,086,150 |
| Chinook salmon..... | 6,780,000 | | 32,780,765 | 39,560,765 |
| Sockeye salmon..... | 350,000 | 38,778,500 | 30,434,500 | 69,563,000 |
| Chum salmon..... | | 7,000,000 | 19,436,400 | 26,436,400 |
| Steelhead salmon..... | 493,000 | 38,810 | 2,928,915 | 3,460,725 |
| Atlantic salmon..... | | 1,387,000 | 280 | 1,387,280 |
| Landlocked salmon..... | 575,000 | 208,115 | 124,250 | 907,365 |
| Rainbow trout..... | 2,553,240 | 414,100 | 3,872,225 | 6,839,565 |
| Blackspotted trout..... | 820,000 | 3,899,100 | 1,000,300 | 5,719,400 |
| Loch Leven trout..... | | | 64,000 | 64,000 |
| Lake trout..... | 2,824,000 | 16,563,300 | 208,500 | 19,595,800 |
| Brook trout..... | 856,890 | 3,642,330 | 7,559,625 | 12,058,845 |
| Grayling..... | | 1,400,000 | | 1,400,000 |
| Smelt..... | 600,000 | 7,000,000 | | 7,600,000 |
| Pike and pickerel..... | | | 540,510 | 540,510 |
| Fresh-water drum..... | | | 34,080 | 34,080 |
| Crappie..... | | | 37,303,900 | 37,303,900 |
| Large mouth black bass..... | | 585,050 | 1,221,905 | 1,806,955 |
| Small mouth black bass..... | | 303,700 | 54,590 | 358,290 |
| Rock bass..... | | | 108,305 | 108,305 |
| Warmouth bass..... | | | 100 | 100 |
| Sunfish..... | | | 30,371,475 | 30,371,475 |
| Pike perch..... | 296,475,000 | 57,385,000 | 108,515 | 353,968,515 |
| Yellow perch..... | 12,000,000 | 176,369,450 | 6,166,435 | 194,535,885 |
| White bass..... | | | 27,170 | 27,170 |
| Striped bass..... | | 70,184,000 | | 20,184,000 |
| Cod..... | 208,800,000 | 175,341,000 | | 384,141,000 |
| Pollock..... | | 455,066,000 | | 455,066,000 |
| Haddock..... | 188,940,000 | 271,880,000 | | 460,820,000 |
| Winter flounder..... | | 1,768,660,000 | | 1,768,660,000 |
| Pole flounder..... | 19,410,000 | | | 19,410,000 |
| Miscellaneous fishes..... | | | 4,935,165 | 4,935,165 |
| Total..... | 1,109,637,130 | 3,626,262,730 | 226,589,545 | 4,962,489,405 |

As compared with 1920, there was a general increase in production of nearly 200,000,000. Species handled in larger numbers were whitefish, cisco, alewife, chum salmon, blackspotted trout, brook trout, carp, pike perch, yellow perch, striped bass, and haddock, while the output of catfish, buffalofish, shad, various Pacific salmon, lake trout, cod, and pollock was less.

DISTRIBUTION OF FISH.

The increased cost of railroad transportation has been accompanied by no increase in the funds available for the distribution of fishes and has necessitated curtailments. The five special railroad cars that were in commission during the year traveled 85,060 miles and detached messengers in charge of minor shipments of live fish traveled 385,988 miles in planting fish in public waters and in filling upward of 9,000 special applications. The cars were employed principally in

distributing fishes of the interior waters, which are assigned on requests of individuals, fish associations, State fishery officials, and officers of the National Park Service and Forest Service. Fishes representing the commercial species are usually planted on the Bureau's initiative on the spawning grounds from which eggs are derived and, in some instances, in barren waters where the conditions favor the development of new and promising fisheries.

In the Bureau's estimates of appropriations for the fiscal year 1923, under the item for the propagation of food fishes, there has been inserted a clause which is intended to bring to the attention of Congress the desirability of instituting a new policy in the distribution of fish produced at the Government hatcheries or obtained in the course of the regular operations. This clause provides that the Secretary of Commerce may make a reasonable charge for fish supplied for planting in any waters in which the public is not allowed to take fish.

RELATIONS WITH THE STATES IN FISH CULTURE.

The numerous States engaged in fish culture are laboring for the same purposes that actuate the Bureau in its operations within the respective States. The field is large, the need for very extensive work is nearly everywhere apparent, and there is no conflict of authority or duplication of effort between the States and the Federal Government. Under the cooperative arrangements that have been made the practical efforts of one agency supplement and augment those of the other, with maximum benefit to the public.

The Bureau acknowledges invaluable assistance afforded by the States during the past year, resulting in reduced expense, augmented output, and increased efficiency in stocking waters. Joint occupation of productive collecting fields and the use of State hatcheries for the incubation of eggs provided by the Bureau, the young fish being planted by the State in local waters in accordance with previous plans, have continued to be features of the interrelations with the States. In the fiscal year 1921 the fish commissions of 28 States were assigned fish and eggs, as set forth in detail in the following table:

ASSIGNMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS DURING THE FISCAL YEAR 1921.

[All figures are for eggs unless otherwise indicated. Fingerlings are designated *a* and fry *b*.]

| State and species. | Number. | State and species. | Number |
|----------------------------------|-----------------|------------------------------------|-------------|
| California: Chinook salmon | 3,000,000 | Iowa: | |
| Colorado: Rainbow trout | 50,000 | Lake trout | 50,000 |
| Connecticut: Brook trout | <i>a</i> 52,000 | Rainbow trout | 62,000 |
| Idaho: | | Maine: | |
| Blackspotted trout | 50,000 | Lake trout | 50,000 |
| Landlocked salmon | 15,000 | Landlocked salmon | 475,000 |
| Rainbow trout | 50,000 | Maryland: | |
| Whitefish | <i>a</i> 7,000 | Cisco | 300,000 |
| Illinois: | | Lake trout | 4,000 |
| Black bass | <i>a</i> 200 | Pike perch | 1,000,000 |
| Catfish | <i>a</i> 25,300 | Rainbow trout | 150,000 |
| Crappie | <i>a</i> 5,800 | Whitefish | 100,000 |
| Drum | <i>a</i> 175 | Massachusetts: Rainbow trout | 50,000 |
| Pickerel | <i>a</i> 410 | Michigan: | |
| Pike perch | <i>a</i> 250 | Landlocked salmon | 10,000 |
| Rock bass | <i>a</i> 500 | Lake trout | 1,000,000 |
| Sunfish | <i>a</i> 20,325 | Pike perch | 223,200,000 |
| White bass | <i>a</i> 175 | Smelt | 200,000 |
| Whitefish | 500,000 | Whitefish | 20,000,000 |

ASSIGNMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS, ETC.—CON.

| State and species. | Number. | State and species. | Number. |
|-----------------------------|-------------|-------------------------------|---------------|
| Minnesota: | | Oregon: | |
| Black bass..... | a 9,340 | Chinook salmon..... | 3,650,000 |
| Catfish..... | a 6,800 | Rainbow trout..... | 604,940 |
| Crappie..... | a 5,200 | Pennsylvania: | |
| Sunfish..... | a 5,200 | Chinook salmon..... | a 10,000 |
| Steelhead salmon..... | 70,000 | Cisco..... | 65,000,000 |
| Yellow perch..... | a 2,250 | Lake trout..... | 50,000 |
| Missouri: | | Steelhead salmon..... | 30,000 |
| Rainbow trout..... | a 100 | Whitefish..... | 10,000,000 |
| Sunfish..... | a 100 | South Dakota: | |
| Montana: | | Brook trout..... | a 2,100 |
| Blackspotted trout..... | 350,000 | Rainbow trout..... | a 3,000 |
| Rainbow trout..... | 150,000 | Tennessee: Rainbow trout..... | 55,000 |
| Steelhead salmon..... | 75,000 | Utah: Lake trout..... | 50,000 |
| Nebraska: | | Vermont: | |
| Brook trout..... | a 32,900 | Lake trout..... | 25,000 |
| Rainbow trout..... | a 30,000 | Landlocked salmon..... | 20,000 |
| Nevada: Rainbow trout..... | 50,000 | Pike perch..... | 14,700,000 |
| New Hampshire: | | Steelhead salmon..... | 25,000 |
| Landlocked salmon..... | 20,000 | Yellow perch..... | 12,000,000 |
| Lake trout..... | 25,000 | Washington: | |
| Pike perch..... | 2,000,000 | Blackspotted trout..... | 75,000 |
| Whitefish..... | 250,000 | Rainbow trout..... | 75,000 |
| New Jersey: Pike perch..... | 1,000,000 | Steelhead salmon..... | 49,000 |
| New York: | | Wyoming: | |
| Cisco..... | 104,410,000 | Black bass..... | a 2,150 |
| Lake trout..... | 1,500,000 | Blackspotted trout..... | 100,000 |
| Landlocked salmon..... | 100,000 | Brook trout..... | 100,000 |
| Steelhead salmon..... | 199,000 | Catfish..... | a 1,200 |
| Whitefish..... | 29,200,000 | Rainbow trout..... | 309,800 |
| Ohio: Whitefish..... | 23,640,000 | Smelt..... | 200,000 |
| Oklahoma: | | | |
| Rainbow trout..... | 100,000 | Total..... | { 484,114,740 |
| Rock bass..... | b 41,000 | | a 236,575 |
| | a 8,000 | | b 41,000 |
| | a 100 | | |

In realization of the great and growing need for more adequate laws for the protection of food and game fishes in various parts of the country, the Bureau has been in communication with the fishery authorities of a number of States. Attention has been directed in certain cases to the lack of suitable laws or to the lack of stringent enforcement of the laws, and the States have been reminded of the stipulation made by Congress in connection with the annual appropriation for the propagation of food fishes, which prohibits the expenditure of funds for hatching or planting fish in any State where, in the judgment of the Secretary of Commerce, inadequate protection is afforded the particular species handled. In every instance the response to the Bureau's communication has shown a desire on the part of the States to bring about any needed reforms in fishery legislation, and there is reason to believe that some States that have been derelict in this matter will enact new and better laws in the near future. It has been the Bureau's policy not to summarily recommend the discontinuance of fish-cultural work in any State, but to use every proper influence to bring the States in line for the maintenance of their fish and other aquatic animals.

The shad hatchery at the head of the Chesapeake Bay, near Havre de Grace, Md., closed by the Secretary of Commerce in 1917 for reasons fully set forth in published reports, has been definitely abandoned, as the State gives no indication or intimation of an intention to meet the conditions imposed by law. The equipment and machinery have been transferred to other stations, the major build-

ings have been razed, and the lumber therein has been used in construction work elsewhere.

Mutually profitable cooperative relations have continued between the Bureau and the Dominion and provincial fishery authorities of Canada. The collecting of spawn of the whitefish and the cisco in the Great Lakes has thus been facilitated, and an exchange of trout eggs for Atlantic salmon eggs has been effected.

COOPERATION WITH FISH-PROTECTIVE ASSOCIATIONS.

A matter of great interest in connection with the fish-cultural work in interior waters is the rapid increase within recent years in the number of fish-protective associations throughout the country. Generally speaking, these organizations are composed of the leading citizens of the community, and the influence they exert in maintaining the fishery resources of the minor waters and in securing a proper utilization of those resources is most beneficial to the public at large. They make a practice of securing the services of men of experience in the stocking of local waters with fish life, and in some cases they maintain, at their own expense, ponds in which to rear to a larger size consignments of young fish obtained from State and Federal hatcheries for planting in public streams, ponds, and lakes. Another important service rendered by such organizations is the respect they inspire for the State fish laws, as most of them advocate adequate protective laws and their rigid observance by their members and the public. The Bureau has been pleased to cooperate with such organizations in the stocking of local waters with the most suitable kinds of fish. The cooperation has had the effect of reducing the expense of distribution and of increasing the chances of survival of the fishes planted.

HATCHING OF RIVER FISHES OF THE ATLANTIC SEABOARD.

Hatcheries for the commercial fishes of the Atlantic coast rivers are located on the Penobscot River in Maine, the Potomac River in Maryland and Virginia, and Albemarle Sound and Roanoke River in North Carolina.

A full discussion of the circumstances attending the artificial propagation of Atlantic salmon on the Penobscot River was contained in the last annual report. The disinclination of the Bureau to continue paying to Penobscot fishermen a bonus for the careful handling of adult salmon purchased from them resulted in the refusal of many of them to sell their fish to the Bureau. The local collection of Atlantic salmon eggs was therefore considerably smaller than usual, but it was augmented by the receipt of 600,000 eggs from Canadian hatcheries, in return for which the Canadian Government was furnished an equal number of eggs of the black-spotted trout and rainbow trout. While it is probably true that the careful handling of salmon taken in the weirs involves a small amount of extra work to the fishermen, this is believed to be more than offset by the benefits accruing to them from the hatchery. Hence, the Bureau feels justified in discontinuing the payment of this so-called bonus. Under the existing arrangement each fisherman receives the market price for his

fish at the time of delivery, and to avoid constant weighing an average weight of $11\frac{1}{2}$ pounds per fish has been established as a basis for computing the cost, this being conceded by the fishermen as a very fair average. The fish thus purchased are released immediately after their eggs are secured, and they undoubtedly return to the river in appreciable numbers in subsequent years. The point of greatest importance, however, is the salvage of a very large percentage of the immature spawn contained in the fish at the time of capture for market.

The shad hatcheries on both the Potomac River and Albemarle Sound were adversely affected by peculiar climatic conditions that prevailed during the spring of 1921. In the former field the first eggs were taken on March 22, the earliest recorded date for spawning shad on the river. This premature spawning was undoubtedly brought about by the warm weather and consequent high water-temperatures prevailing in the latter part of February and in March, the minimum water temperature recorded at the Potomac River station during March being 40° F. An unfavorable reaction was occasioned by the abnormally cold weather in April and early May, when the season was brought to a close. Equally unsettled weather prevailed in the Albemarle Sound region, and to this fact, together with the very extensive fishing operations permitted in the sound, the reduced output of the station is due.

It should not be necessary to emphasize the great need for immediate restrictive measures if the shad is to be saved in the few remaining rivers where the run still persists in sufficient volume to be commercially attractive. The subject has been a prolific source of discussion, but the various States most intimately concerned and responsible for the conditions have apparently made no progress toward ameliorating the situation. It is pertinent to note that the weather which was so unpropitious for the hatcheries actually favored a large catch of fish in the pound nets in the lower reaches of Chesapeake Bay and Albemarle Sound.

Very good results attended the initial attempt to propagate the glut herring or alewife on Albemarle Sound, and over 55,000,000 eggs were collected for the Edenton hatchery and nearly 44,000,000 fry were produced. The hatching of striped bass on the Roanoke River was conducted as usual in the spring of 1921, and, notwithstanding unfavorable weather, the collection of eggs, amounting to 24,620,000, was larger than in any previous season.

PROPAGATION OF COMMERCIAL FISHES OF THE GREAT LAKES.

The most important commercial species of the Great Lakes—whitefish, cisco, lake trout, and pike perch—were handled along the customary lines, and, with the exception of the lake trout, all showed a satisfactory increase in output as compared with the previous year. This increase was made possible largely by favorable weather conditions, although in the case of the cisco the egg collections were greatly augmented by the receipts from new fields in the Canadian waters of Lake Ontario.

The need of a hatchery at some point on Saginaw Bay to take care of the immense numbers of pike perch and yellow perch eggs avail-

able in that field and now going to waste was again demonstrated by the collection of upward of 277,000,000 eggs of the former species. Owing to the lack of hatching facilities most of these eggs had to be sent to the State hatchery at Detroit for development.

In response to the continued demand for Government aid in maintaining the supply of carp in the western end of Lake Erie, large numbers of eggs of that important fish were obtained for hatching in cooperation with the Ohio fishermen.

PROPAGATION OF THE PACIFIC SALMONS.

Hatching and rearing of the Pacific salmon are conducted in California, Oregon, Washington, Idaho, and Alaska, and all of the five species, together with the steelhead, are usually handled, although in the past fiscal year no eggs of the pink salmon were secured.

There was a good run of chinook salmon in the Oregon and California fields, and the only reason for not obtaining record-breaking collections of eggs was that very heavy floods occurred at the height of the spawning season, permitting the escape of the fish that were being held below the racks. The floods were especially severe in California, interrupting all railroad and highway travel for a number of days. The work was therefore a practical failure at all points in those States.

At the new location on Snake River, Idaho, a collection of 6,000,000 chinook eggs from the spring run of salmon was made. The floods in this region during the fall of 1920 were in sharp contrast to the conditions encountered during the preceding fall, when the prevailing drouth and low-water stages in the spawning streams were such as to seriously handicap the work.

Owing to the limited funds available for salmon work in the Washington field, the two substations closed last season were not reopened. The run of chum salmon in Hood Canal was considerably larger than last year, thus permitting increased egg collections at all the Federal stations in that region. This outcome is attributed to less extensive commercial fishing as a result of the decided drop in price. The operations at Baker Lake were even more favorable than last year, and the collection of sockeye salmon eggs, amounting to nearly 12,000,000, was the largest since the establishment of the station more than 20 years ago; these eggs were taken from 3,645 fish.

The experiment recently undertaken at the substation at Quinault Lake for the purpose of demonstrating the relative efficiency of artificial propagation and natural reproduction has been temporarily postponed, as it was found that many of the fish passing through the counting weir were being gilled in the 4-inch mesh webbing used in its construction. Approximately 12,000 fish had been counted before the necessity for discontinuing the work became apparent.

At the Yes Bay (Alaska) hatchery no egg collections whatever were attempted during the fiscal year, and fish-cultural work was restricted to the incubation of a limited number of eggs transferred from other points. This course was necessitated by the condition of buildings, water-supply system, and equipment. In order to prevent complete deterioration of valuable property, extensive repairs and improvements were required. No special appropriation for this

purpose was allowed by Congress, and the allotment ordinarily made for the regular operations of the station had to be devoted to upkeep of the plant.

There was again a large run of sockeye salmon into Litnik Lake, on which the Afognak station is located, and while the egg collections were not equal to the previous year's, when the hatchery was filled and additional eggs were taken for incubation in gravel boxes, the shortage was caused by the occurrence of floods during the spawning period rather than to any diminution in the run of fish.

As evidence of the trend and progress of salmon culture on the Pacific coast, it may be noted that of the 124,484,000 salmon planted by the Bureau in the last fiscal year 92,066,000, or over 71 per cent, were of the fingerling size.

CULTIVATION OF FISHES OF INTERIOR LAKES AND STREAMS.

The diversified and widespread fish-cultural work addressed to the food and game fishes of the streams and minor lakes of the interior has been conducted along the usual lines. The principal species involved are various trouts, landlocked salmon, black basses, crappies, sunfishes, and buffalofish. One of the fishes in this class most in demand and most desirable for planting over a wide range of country is the eastern brook trout. The production at all the trout stations is not sufficient to meet the demand, and recourse has been had to private hatcheries for supplies of eggs. The high prices now asked for such eggs, however, have necessitated a curtailment of purchases, and the shortage has been augmented by a poor take of eggs in Colorado, usually one of the most productive fields. The situation emphasizes the desirability of developing as rapidly as possible the proposed brook-trout station in the White Mountain National Forest at a site that has been made available to the Bureau through the courtesy of the Forest Service and the State of New Hampshire. A large part of the preliminary work connected with this project has been completed, surveys have been made, a road constructed, telephone line installed, a portion of the pond extension site cleared, and a temporary dam constructed. The officers of the Forest Service have rendered valuable assistance in the accomplishment of this work, but the station can not be fully developed and put in operation until additional funds are provided. The special appropriation requested for the purpose seems very small when compared with the results that may reasonably be expected from such an undertaking.

Successful results attended the fish-cultural activities of the stations in the Rocky Mountain region, with the single exception of the Colorado field, where the work was adversely affected by the inclement weather and the serious difficulty in transporting the eggs from the isolated field stations. Good collections of rainbow trout eggs were made in Madison Valley, Mont., notwithstanding the continuous cold and stormy weather prevailing throughout the spawning season. Aside from other valuable assistance rendered by the Montana Game and Fish Commission, the Bureau is indebted to it for its entire output of grayling. The work in the Yellowstone National Park was of a satisfactory nature, and upward of 2,000,000

young blackspotted trout were returned to its waters during the season. The Glacier National Park hatchery was well stocked with eggs shipped from other hatcheries and produced therefrom an output of over 2,000,000 fry and fingerlings of the brook trout, rainbow trout, blackspotted trout, and grayling, in addition to approximately 450,000 fingerlings which were on hand at the close of the year.

Under the handicap of exceedingly difficult natural conditions successful rainbow trout collecting operations were conducted in Wyoming on Sage Creek, Lost Creek, and Canon Creek, the two last named being in fields which have never heretofore been exploited. The results obtained, despite the very limited means available, appear to demonstrate beyond question the wisdom of establishing a permanent collecting station on Sage Creek in order that the work may be handled in a manner in some degree commensurate with the potential value of the field. This stream is a tributary of the North Platte River, and as the other streams mentioned are within a few miles of it the eggs obtained from them and from other collecting points in the Pathfinder reclamation project could be assembled and incubated in a properly equipped hatchery on Sage Creek.

The efficiency of the Spearfish (S. Dak.) station has recently been increased as the result of an arrangement with the city authorities of Spearfish. Under the provisions of a long-term lease the Bureau has secured without cost all surplus water from a reservoir lately constructed by the city. While this arrangement is satisfactory and gives the station an ample amount of water during the greater part of the year, with a surplus most of the time, the supply falls to a minimum during summer, when unusually large amounts of water are used for domestic purposes. In order, therefore, to provide against a shortage of water for the work at any season, it will be advisable to provide a storage reservoir for emergency use. A suitable reservoir can be constructed at small cost by placing a dam in a canyon on property adjacent to the Bureau's reservation, and with this additional outlay the station would be assured of an adequate water supply for an indefinite period of time.

In the propagation of the domesticated rainbow trout the results show continued improvement as to both quality and quantity of eggs and fry. Small consignments of eggs taken from wild rainbow trout at the western stations have been transferred to the eastern hatcheries from time to time to maintain the virility of the brood stock, and by this means no difficulty whatever is experienced in producing this species in sufficient numbers to meet all requirements. Recent anatomical studies of the rainbow trout conducted by the division of scientific inquiry have disclosed a number of facts relating to the reproductive organs of the female fish that have heretofore been overlooked or were not understood at the hatcheries and may have an important bearing on fish culture, especially with regard to the manipulation of spawning fish. The experiments were conducted at the Wytheville (Va.) station, and preparations have been made to continue them indefinitely at the Erwin (Tenn.) station, or until the problems involved can be fully worked out. The scientific division has also rendered assistance in overcoming the mortality which usually occurs among adult trout at spawning time. A careful examination of specimens of trout dying during that time

has revealed the cause of death in many cases, and remedial measures have been suggested to the superintendents of trout stations.

Efforts to find a satisfactory food for young salmonoid fishes at a lower price than the expensive meat products in general use have been continued. Canned herring milt has been found to have some value when used in combination with meat, but used alone it has not yielded good results, as it appears to lack some important requirement of a full meat diet.

Climatic conditions during the 1921 nesting season of the basses were very unfavorable for a large output of fish. A period of unseasonable warmth in March unduly advanced the spawning season. This was followed by a cold spell in April and variable weather in May, such conditions appearing to prevail all over the country. A sudden fall in water temperature invariably causes spawning bass to desert their nests, with a subsequent loss of the eggs deposited. The bass output was therefore curtailed at practically all stations, and at some of them it was a complete failure.

In cooperation with the fishery authorities of Minnesota, investigations were made with the view of determining the feasibility of making collections of pike-perch eggs in the Rainy Lake region of that State. Operations were conducted at two sites, and eggs to the number of 13,680,000 were obtained as the Bureau's share of the returns.

On the Atchafalaya River, in Louisiana, 96,440,000 eggs of the buffalofish were taken between February 27 and March 25, 1921, the collections being materially reduced below those of the preceding year by the short spawning season and the small numbers of fish available. These unfavorable conditions are attributed to the late rise in the river, which, occurring in January, acted as an incentive to the fish to pass by their usual spawning grounds and seek more inaccessible spots in the denser portion of the flooded swamps. The catch of fish along the river was reported by local fishermen to be the smallest since 1913.

Taking advantage of an opportunity to save eggs of buffalofish and carp on the Mississippi River at Bellevue, Iowa, and Lynxville, Wis., during the spring of 1921, the Bureau collected 68,267,000 eggs of the former and 42,712,000 of the latter species, all of them being secured from fish caught for the market by commercial fishermen. The eggs were fertilized and immediately planted on the spawning grounds in the river.

HATCHING OF MARINE FISHES.

Operations in this branch were conducted at the usual points in Maine and Massachusetts and were addressed to the cod, pollock, haddock, winter flounder, and pole flounder. The weather throughout the spawning season of the various species was favorable, resulting in the taking of eggs of better than average quality at a lowered cost of production. There was a reduction in the number of cod and pollock eggs taken as compared with the previous year. A rather sharp decline in the price of pollock deprived the local fishermen of an incentive to pursue the fishery, and the catch at Gloucester fell off about 70 per cent. The collection of eggs for hatching purposes

was necessarily affected, as the only source of supply is the fish caught for market. As against more than 954,000,000 taken in 1920, the past season's collections reached only 650,000,000.

The shortage in cod eggs may be ascribed to somewhat similar, though not identical, conditions. The body of cod on the shore grounds appeared to be smaller than usual, and as the market price of haddock offered more lucrative employment for the fishermen comparatively few boats engaged in the cod fishery. Egg collections of this species in the Gloucester field amounted to 210,040,000, while 214,702,000 were secured from brood fish held at the Woods Hole hatchery. Haddock eggs to the number of 629,120,000 were obtained for the Gloucester station between January 22 and April 29, 1921, this number exceeding the previous records for that species.

Weather conditions were generally favorable for flatfish propagation, and the egg collections at all stations aggregated 1,980,291,000, an increase of 175,000,000 over the previous year. High water-temperatures occurring toward the latter part of the season in the Woods Hole region and an unusually early ending of the spawning in Maine waters were factors in curtailing the take of eggs.

The artificial propagation of the pole flounder (*Glyptocephalus cynoglossus*) was undertaken by the Bureau for the first time during the past year. The presence of this fish in New England waters has long been known, but, because of its peculiarly small, soft mouth it was not taken by fishermen on the hand lines and trawl lines commonly used. With the coming into general use of the otter trawl in the shore fisheries of the section the pole flounder has made its appearance in the markets in constantly increasing numbers, and because of its food value and excellent flavor it commands a ready market at a high price. With the view of encouraging and assisting a new and growing industry an experienced spawn taker was detailed to investigate the spawning habits of this species. A close watch was kept on the fish landed at the markets during April and May, but no fully matured eggs were found until May 22. From that date to the end of June 19,410,000 eggs were collected, fertilized, and planted on the spawning grounds, and several small lots were taken to the Gloucester hatchery for observation. The eggs are semibuoyant, nonadhesive, and about 0.05 of an inch in diameter, measuring approximately 462,000 to the fluid quart. Those placed in a Chester jar for incubation did not survive, but the freer circulation of the McDonald tidal box appeared to meet their requirements. It is believed that the hatching of this fish can be profitably extended during the coming season.

RESCUE OPERATIONS IN MISSISSIPPI VALLEY.

The salvaging of food fishes in the overflowed waters of the Mississippi and Illinois Rivers has continued to be a prominent adjunct of the fish-cultural service. In the 1920 season, as early as the water stages would permit, this work was begun and continued without intermission as late as weather conditions were favorable. Owing to the persistence of high water much beyond the usual time, many millions of young fish, which under ordinary circumstances would have been left to perish in isolated pools and sloughs, were able to

In 1889 a man named Morse established a cannery at Seattle and operated it for only one year.

The first Puget Sound sockeye cannery was built at Semiahmoo, near Blaine, by J. A. Martin and John Elwood about the year 1891. It was bought in 1892 for \$500 by D. Drysdale, who shortly afterward rebuilt and greatly enlarged the plant. In the same year Mr. Drysdale demonstrated the commercial success of fish traps. Traps had been in operation before this, however. In 1893 Ainsworth & Dunn had a trap at Five Mile Rock, just beyond the lighthouse at Magnolia Bluff (now a part of Seattle), and there had been a trap or two in Elliott Bay even prior to this. Traps had not been profitable in this section, however, owing to the cheapness and abundance of salmon, haul seines being cheaper and more profitable to operate. A man named H. B. Kirby, who came originally from Nova Scotia, and another named Goodfellow (now living at Point Roberts) put in the first trap for Mr. Drysdale.

From this time on the industry fluctuated considerably, 41 canneries, an increase of 10 over 1914, being operated in 1915, while 35 were operated in 1919.

During the early years of sockeye canning they were not sold to the trade as sockeyes, but as Alaska reds and Columbia River salmon, for which there had been an established market for some years.

H. Bell-Irving & Co., of Vancouver, British Columbia, were the pioneers in the labeling of the fish as sockeyes, this being in 1894-95. Like all virtually new products, sockeye salmon had a hard fight for several years to secure a foothold in the salmon markets, and it was not until the Spanish-American War in 1898 caused a heavy demand for canned foods that its position became finally established.

Soleduck River.—This is a small stream, about 30 miles in length, which flows through the southwestern part of Clallam County and empties directly into the ocean. The Quillayute Indian Reservation is located here and the natives formerly caught salmon and marketed them on Puget Sound, but a small cannery, started at Mora, on this river, in 1912, furnished a market for the catch up to the end of 1915, when it was abandoned.

Hoh River.—This is a comparatively small river, which is wholly within Jefferson County, and debouches into the ocean in the northwestern part of the county. It passes through the Hoh Indian Reservation in its lower reaches. A cannery was built here in 1917 by Fletcher Bros., and has been operated each season since. In the spring of 1919 it was moved to a more convenient location about a mile from the original site.

Queets River.—This river, which is about 35 miles long, rises in the northern part of Jefferson County and empties directly into the ocean in the northwestern part of Grays Harbor County, within the bounds of the Quinault Indian Reservation. A small salmon cannery was built at Queets, in Jefferson County, in 1905, and has been operated every season since.

Quinault River.—This river, which enters the ocean in the northwestern part of Grays Harbor County, has a length from the ocean to Quinault Lake of about 40 miles, wholly within the boundaries of the Quinault Indian Reservation.

This stream is especially noted for its long-continued annual run of Quinault salmon (*O. nerka*). These fish, which are noted for

their especially red-colored flesh, make their appearance early in December, when the Indians generally catch them for their own use, as they fear that, if the whites got hold of the fish, they might throw away the hearts. Should a heart be eaten at this time by a dog or chicken, the Indians believe the run would not come. In January, when the fish begin to be abundant, all danger of this seems to have passed, for the Indians then usually have a considerable number for sale, and these are generally shipped to distant markets in a fresh condition by the buyers. As soon as the canneries open at Moclips most of the fish are disposed of at that place. The run continues up to July 1. May and June are the best fishing months.

There is a fall run of chinooks in this river, which usually arrives in August and ends about October 15.

The silver salmon appear about October 1 and the run is generally over by November 15; the dog salmon appear about November 1 and the run is usually over by the middle of the same month, while the steelhead trout run between November 20 and May 1. None of the latter are canned.

Moclips, the terminus of the railroad, is about 10 miles from the river, and the fish are all taken by team to this place. Twenty fish, weighing approximately 100 pounds, are put in each box, and these are piled onto the wagons until a load has been accumulated. The team owners get 50 cents a box for hauling the loaded ones to Moclips and 5 cents a box for bringing the empty ones back.

In 1915 the records of the Indian agent show that the Indians fishing on the north side of the river caught 219,654 Quinault salmon, valued at \$49,820, while those on the south side caught 135,353 of these fish, valued at \$30,528.60, or a grand total of 355,007 fish, valued at \$80,348.60. This does not take into account the results of the fishing for the other species of salmon and steelhead trout, which quite materially swell the total.

Fishing is restricted to the Indians, who also make their own fishery laws, with the advice and approval of the Office of Indian Affairs, as the State laws have no force inside the bounds of the reservation. Under the regulations now in force, a clear channel of one-third the width must be left in the middle of the stream, which is from 250 to 300 yards in width. Each owner of a fishing location has to fish it in person; provided, however, that widows, orphans, minor children, old Indians, and those who are sick or have gainful occupations other than fishing, are allowed to lease their locations or hire some one to fish them, and then only with the approval of the officer in charge.

During the Quinault season stake nets are used, while the rest of the time, as a result of the freshets, drift gill nets are used in the eddies. The stake nets are arranged in a rather peculiar manner. A line of stakes is run out for about one-third the width at right angles to the shore, and to these are attached a net by short ropes. From each stake a section of net is run out and downstream, curving inward like a hook at the end, the latter part being held in place by three stakes.

The stake nets are 40 to 60 meshes deep, with 5½-inch stretch mesh, and are set 85 yards apart. A set of these as described above forms one fishing location.

immediate curtailment in production became necessary before the program of expansion had been completed and while the costs of labor and materials were still advancing. Prices of fishery products for domestic use and for export fell and operations in many fields became unprofitable. Thus the fishing industry was one of the first to feel the necessity for postwar readjustments and to respond to that necessity.

As instances of recent marked changes in the fishery industries it may be noted that the decreased production of the New England vessel fisheries between 1918 and 1920 exceeded 25,000,000 pounds, the pack of sardines in Maine and California fell off 800,000 cases, and the output of canned salmon dropped 3,000,000 cases. The curtailment of operations in 1921 promises to be even greater in certain branches, as the trawler fleet of New England has been idle much of the time and a reduction of 50 per cent in the number of operating canneries is reported, and because of unsettled conditions in the oil and fertilizer trades a number of whaling and menhaden plants have been idle. As indicative of the trend of the great foodfish fisheries out of New England ports the landings during the first six months of 1921 compared with the same period of 1920 showed a decline of nearly 15 per cent in quantity and over 31 per cent in value, and the average price of all fish dropped from 4.6 cents to 3.68 cents per pound. The unfavorable situation has been further complicated by high transportation rates on fresh fish, which have discouraged shipments and shortened the distances over which it is practicable to send many of the low-priced fishes. It is to be said to the credit of the industry that it is striving wholeheartedly to meet the untoward conditions, to make sacrifices, and to practice such economies and to adopt such new policies as may be necessary to cope with the situation.

Under these circumstances it is not surprising that there should have been a widespread public appeal to the Bureau for some kind of assistance. Without enlarged provision of authority and funds for work in this field the Bureau's ability to serve the industry has of necessity been limited. Nevertheless, it has been able to render practical aid in numberless cases by suggesting ways and means for effecting improvements or economies in the methods of handling, manufacturing, and merchandizing water products and by widely disseminating timely statistical and other information for the use of fishermen, dealers, manufacturers, and consumers.

The following may be mentioned among the activities during the past year: The initiation of a fishery intelligence service on the north-east coast for supplying information relative to the presence of schooling fish; the effecting of arrangements for an extended trial of seaplanes as an adjunct of the fisheries; the collection of information regarding the construction and operation of little-known types of fishing gear that are adapted for more general use in our fisheries; recommendations for improvements in the methods of handling and shipping fish as an aid to increased consumption and better prices; assistance to producers in securing and transporting materials, such as salt and barrels, required for immediate use at a time when fish were available; the practical application of methods developed in fish-salting investigations; the dissemination of information on the preservation of fish nets; the stimulation of the saving and use of

by-products of the fisheries, including the manufacture of fish meal, leather, and pearl essence; the initiation of a series of surveys of certain primary inland markets; and studies of the methods of conducting certain fisheries and their effects on the supply.

The statistical inventories completed during the year included the vessels fisheries centering at Boston and Gloucester, Mass.; Portland, Me.; and Seattle, Wash.; the shad fishery of the Hudson River and the shad and alewife fisheries of the Potomac River; the sardine industry of Maine; and the fisheries of the New England States. There has been an increased demand for and use of the general statistical information gathered and published by the Bureau, and there is evidence of growing appreciation of the need of support for worthy conservation measures, the necessity for which is disclosed by the statistical data. A full account of the activities of this branch of the service, with detailed tables and discussions of the results of various canvasses, is embodied in a report of the division of fishery industries for 1920 (issued as Document No. 908).

FISHERY INTELLIGENCE SERVICE.

The daily patrols by seaplanes of the Naval Aviation Service of the menhaden fishing areas in Chesapeake Bay and along the coast between Assateague and Bodie Island Lights begun in June, 1920, were continued until October, when the Navy Department abandoned them on the ground that the experiment had fully demonstrated the commercial value of planes in this fishery. This service was very beneficial to the menhaden industry and was the first thorough test of the value of seaplanes in spotting schools of fish. Under the present unsettled conditions in the fish oil and fertilizer industries it is not to be expected that a service of this kind will be established by the fishery interests.

The Bureau has obtained the cooperation of the Director of Naval Communications and the Commissioner of Lighthouses whereby reports of the presence of schooling fish are transmitted daily by radio by the keepers of certain New England lightships to shore stations from which they are forwarded to the Bureau's local agent in Boston. This service was begun about November 1, 1920. Reports of schooling fish are forwarded to the Bureau's local agents in Gloucester, Mass., and Portland, Me., by the Boston agent. Lightkeepers have reported the presence of such fish as mackerel, menhaden, and pollock. The subject has not received a sufficient trial to determine its practical value to the industry or the desirability of extending it to include a number of advantageously located lighthouses.

STUDIES OF FISHERY METHODS.

Descriptions and diagrams of little-known fishing gear, such as paranzella and lampara nets used in the fisheries of California, have been published for the information of the trade. The paranzella net has been used in the Mediterranean for a long period and was introduced into California in 1876. It is a heavy, strongly constructed net, intended for dragging the bottom chiefly in deep water. It is operated with steam and power boats in a manner similar to the otter

trawl, except that two vessels are required. The nets vary in length from 25 to 35 fathoms, and the catch of food fish consists principally of flounders. The lampara net, used chiefly in the capture of sardines, anchovies, and other small surface fish, was introduced from the Mediterranean about 1900. It is fished at or near the surface, usually on dark nights, as these fish can more easily see the net in daylight or moonlight and avoid it, and may be operated by one or two boats, the net being laid around the school of fish after the manner of the purse seine. Studies of the methods of conducting the fisheries and of the effects of various methods of fishing on the supply are in progress.

IMPROVEMENT IN HANDLING FRESH FISH.

Fresh fish being a highly perishable commodity, whose delicate flavor and attractive qualities may be quickly impaired by improper handling, the first requisite to an increased appreciation of the value of such fish for food and to increased consumption is to improve the quality of the product offered to the consumer by the adoption of improvements in handling and distribution. The more important of these recommended by the Bureau are: The elimination of the pew or fork, and where its use is unavoidable or can not be immediately suppressed the employment of only a one-tined fork to be inserted into the head or tail but not in the body of the fish; the avoidance of needless bruising and rough handling; the prompt removal of the body heat by precooling, either on the vessel or at the landing wharf; the use of shallow boxes rather than barrels for shipping purposes, as fish in such receptacles keep longer and have better appearance; the use of an abundance of crushed ice to properly preserve the fish without unnecessary bruising; the observance of every precaution which will tend to retard deterioration; and to offer for sale only sound fish displayed in an attractive manner amid sanitary surroundings. The fish trade should exercise as much care in handling fresh fish as is now used in the handling of choice fruits.

FISH-MARKETING SURVEY.

Appreciating the lack of detailed information on marketing conditions existing in the larger inland distributing and consuming centers, and believing that a survey of certain of these markets may yield information of intrinsic value to the fresh and frozen fish trade and aid in increasing the consumption of fish, the Bureau initiated such a survey in June, 1921, beginning with Louisville, Ky., a city of nearly 235,000 inhabitants.

Among the items concerning which it is planned to secure information are the following: Lists of wholesale and retail dealers, indicating the kinds of fish each handles; geographical sources of supply; available transportation facilities and rates; character of containers in which fish are received and reshipped; population and preference by nationalities for particular classes of fish; months of abundance of the leading species; opinions of the trade regarding trade prospects, etc.

In the Louisville market less than 40 species of fresh and frozen fish and other aquatic forms are marketed. There are but 2 whole-

sale firms who also retail and 12 firms engaged solely in the retail business, half of whom are located on the same street. The disadvantages of this centralization are counterbalanced in part by the fact that a large number of grocers and butchers handle fish on Fridays. This market has a decided preference for fresh-water species and a prejudice against salt-water forms, which must be overcome by educational means if the demand for salt-water forms is to be largely increased. The estimated consumption of fish is about 6 pounds per annum per person.

INCREASING THE CONSUMPTION OF FISH.

Owing to the lack of funds for continuing the demonstrations in fish cookery and in popularizing the less-used fishes, the operations in this field have been largely limited to the issuance of printed matter and its judicious distribution. Economic circulars and placards emphasizing the food values, good qualities, and low prices of haddock and of pink and chum salmons were prepared for the use of the trade, as were also a poster and a leaflet recommending frozen fish.

With the introduction of steam trawlers there has been a heavy increase in the production of haddock, the vessel landings at Boston and Gloucester in the 1918-1920 period being about double the landings for 1908-1910. The haddock catch in New England in 1919 amounted to 89,405,600 pounds, and the average price received for the fish was 2.84 cents per pound. The haddock is taken in quantity throughout the year, can be distributed well if properly handled, and is an excellent white-meated fish similar to the cod. The demand for this fish in some of the inland markets is increasing, but the prejudice against marine fishes is a retarding factor. The economic circular contains 31 recipes for cooking this fish.

The consuming public has been educated to the high quality of red-meated salmon, but does not appreciate the excellence of pale-fleshed fish. While pink and chum salmons usually have less fat than the more highly colored forms, they contain as much tissue-building material. More than 3,250,000 cases of these fish were packed in 1920, and at recent prices they represent one of the lowest priced protein foods on the market. The Bureau has lent its assistance in educating the public to an appreciation of these fishes, which may be kept indefinitely when canned, are ready for immediate use, and may be prepared in many ways.

The Bureau has encouraged the wider use of frozen fish, as freezing conserves fish in times of abundance and cheapness for use in times of scarcity, and as a rule fish are now frozen under excellent conditions. The printed matter distributed through the trade stresses the importance of keeping frozen fish at a low temperature, of never thawing and refreezing, of avoiding bruises and rises in temperature, and of buying the fish while frozen and placing them in an ice box or cool place for thawing before cooking.

TECHNOLOGICAL INVESTIGATION.

Owing to lack of funds for operation, the fishery products laboratory in Washington City was practically idle during the year, and the temporary laboratory at San Pedro, Calif., was loaned to the California State Fish and Game Commission.

The practical application of methods evolved in the investigation of the principles of preserving fish with salt has been embodied in a report entitled "Improvements in Process of Salting River Herring, Especially Adapted to Warm Climates" (issued as Document No. 903). The report is based on the results of actual field tests in Florida designed to overcome the failures heretofore experienced by fishermen, and the fundamentals of the method, which should be followed wherever fish are to be preserved by salting in a warm temperature, are: Careful handling of the fish before salting, thorough cleaning and removal of all blood, use of salt of a high degree of purity, and application of the salt in a dry state.

A report on the preservation of fish nets has been prepared and published (as Document No. 898). This important means of economizing in the expense of nets has been largely neglected in this country. In view of the fact that our fishermen employ gear to a value exceeding \$15,000,000, a large part of which is in twine, and in view of the increasing cost of such netting such information is greatly needed and has been appreciated. The document sets forth the fundamental principles governing net preservation and gives for use those recipes which seem best calculated to serve the purpose of the fishermen. The Bureau has initiated some additional studies in net preservation which it plans to continue as opportunity affords in order that the industry may benefit to the fullest possible extent through the application of desirable methods.

For investigations in the refrigeration of fish the Bureau has a modern air-freezing plant with a sharp freezer capable of producing a temperature of -40° and automatic carbon-dioxide compressor and controls; a plant for freezing fish in brine; a precision temperature-measuring apparatus consisting of precision thermometer, Wheatstone's bridge, precision double potentiometer, conductivity apparatus, etc.; and a commercial apparatus for the experimental utilization of frozen fish. This equipment has been assembled and prepared for use in the conduct of investigations for which the trade lacks information as well as facilities. In view of the widespread interest in the industry in the freezing of fish in brine, this subject is to be investigated in detail, and considerable preliminary work has been completed.

INCREASING THE USE OF BY-PRODUCTS OF THE FISHERIES.

The Bureau has continued to aid in increasing the saving and use of the by-products of the fisheries with most gratifying results. It is inevitable that the year 1921 will show a heavy curtailment in production owing to unsettled market conditions. Fish oils now command about a fourth and fish scrap less than half war-time prices, while costs of operation and transportation have declined but little.

It is estimated that in 1920 the production of scrap and meal from all fishery products in the United States including Alaska was in excess of 125,000 tons. Of this amount the Pacific coast is to be credited with nearly 17,000 tons. As a result of the Bureau's work on the Atlantic seaboard there was a large increase in the production of fish meal for stock-feeding purposes, and menhaden and

other interests are well pleased with the advantages accruing from the development of an additional outlet. The trade is energetically building up markets to care for the increased production. The Bureau of Animal Industry has continued its cooperation in the conduct of feeding tests and in educating farmers to the value of this commodity and is issuing a publication giving the results of the feeding tests. There are numerous problems that have arisen in connection with the utilization of waste fish which should receive attention from the Bureau of Fisheries, and it is hoped that means for studying these may soon be provided.

On the basis of reports published by the Bureau of the Census the production of fish and marine mammal oils in 1920 amounted to 8,803,574 gallons, distributed as follows: Menhaden oil, 3,676,453 gallons; whale oil, 3,073,574 gallons; sperm oil, 416,737 gallons; herring oil, 380,379 gallons; cod and cod-liver oil, 196,108 gallons; and all other, 1,060,322 gallons.

The fishery for sharks is developing satisfactorily despite unsettled conditions in the fishery industry, and the number of persons and companies attempting to place the fishery on a permanent basis is increasing. Shark hides are being tanned into leathers which are excellent for shoes, bags, brief cases, collar boxes, bill folds, and similar articles. Wearing tests of shoes with uppers of shark leather indicate that such leather is fully comparable to the best grades of calfskin, and shark leather has been produced whose tensile strength exceeded 6,500 pounds per square inch.

As the Bureau's small special appropriation for work in this field has lapsed, the future aid that can be given this industry will of necessity be limited. With the establishment of the facts that high-grade leathers can be made from the hides and that the remainder of the fish can be converted into marketable commodities, the chief purposes of the Bureau's assistance have been served. There is still need for information relative to the possible extent of the fisheries and areas and seasons of greatest abundance of sharks, but with a certainty of markets for the products it is believed that private enterprise will be able to cope with the situation.

It is worthy of report that a number of American manufacturers are now engaged in the manufacture of "pearl essence" or "fish-scale essence" from the scales of native fishes, such as the river herring, sea herring, and shad, and that considerable quantities of the scales are now being utilized for the purpose. In 1919, 5.2 tons of alewife or river herring scales, valued at \$5,200, or 50 cents per pound, were so used in Massachusetts, and at present silvery scales are being saved by the fishermen of Maine, Massachusetts, and Virginia.

FISHERY CONFERENCES.

The Secretary of Commerce has adopted the practice of calling from time to time conferences of men interested in the upbuilding of the fishing industry. These conferences have been well attended and promise to mark an epoch in the history of the industry by establishing closer relations between the industry and the Federal agencies concerned and by affording a better understanding of the problems which the industry is attempting to meet, of the means

whereby Federal agencies can cooperate, and of the limitations beyond which these agencies can not go.

The first of these conferences, attended by about 30 men prominently identified with the industry from the Atlantic and Gulf coasts, the Great Lakes, and the Mississippi Valley, representing the fresh, frozen, salt, and canned fish trades, and the oyster, crab, shrimp, and menhaden industries, was held at the Department of Commerce on May 9 and 10, 1921. The conference in a formal expression of views emphasized the seriousness of polluted coastal waters as affecting the fisheries and the need for remedial legislation; the effects of high transportation rates on the marketing of fish, especially of the lower-priced grades; the desirability of educational work among all classes to improve the quality of fish marketed and increase the consumption of fish; and the need of closer cooperation for the protection of important migratory fish.

The second conference, held on June 16, 1921, was called to consider measures for the prevention and control of water pollution and the protection of anadromous and shore fishes and other aquatic forms. It was attended by about 70 conferees, State fish commissioners, fish producers, and anglers from the Atlantic and Gulf coasts, as well as by Members of Congress and interested Federal departmental officials. The conference revealed a very great increase in the quantity of undesirable material dumped into our coastal waters in recent years, with impairment of their use for bathing and other recreation purposes and resultant damage to aquatic life, to which may be added the menace to our cities from fire due to oil on the water. There was indicated a general failure or inability of the States to cope with the many important and complex problems involved, and the demand for assistance from the Federal Government was practically unanimous.

On the question of the control of migratory fishes there was a greater diversity of opinion, but it was the sentiment of the meeting that our anadromous fishes and certain shore forms require greater protection that may be attained through uniform State action, the Department of Commerce to use its best offices to the accomplishment of this end in an advisory capacity.

NEW ENGLAND VESSEL FISHERIES.

The Bureau, through its local agents, has collected detailed statistics of the extensive vessel fisheries centering at Boston, Gloucester, and Portland, which have been published in monthly and annual bulletins. Two annual bulletins have been issued, one showing the catch by months, the other by fishing grounds. The number of trips and the catch at these ports were not so large as in the previous year, but there was a considerable increase in the total value of the products. There was a large increase in the fishery products landed at Boston during the year, but a decrease in the receipts at Gloucester and Portland.

The fishing fleet at these ports during the calendar year 1920 numbered 471 sail, steam, and gasoline-screw vessels, including 41 American and 3 Canadian steam trawlers. These vessels landed at Boston 3,342 trips, aggregating 118,558,902 pounds of fish, valued at \$6,136,569; at Gloucester 2,381 trips, aggregating 46,740,296 pounds, valued

at \$1,460,336; and at Portland 1,883 trips, aggregating 12,981,503 pounds, valued at \$630,108. The totals for the three ports were 7,606 trips and 178,280,701 pounds of fresh and salted fish, having a value to the fishermen of \$8,227,013.

The foregoing totals include 54 trips—43 at Boston, 1 at Gloucester, and 10 at Portland—landed by 18 Canadian fishing vessels, amounting to 2,588,218 pounds of fish, valued at \$119,028. Of this quantity, 1,308,774 pounds, valued at \$62,147, were landed at Boston; 271,580 pounds, valued at \$13,606, at Gloucester; and 1,007,864 pounds, valued at \$43,275, at Portland. As compared with the previous year, there was an increase of 9 vessels and 15 trips but a decrease of 707,929 pounds, with an increase of \$12,767. These fish were brought into American ports in accordance with an arrangement with the Canadian Government as an emergency war measure that granted reciprocal privileges to fishing vessels, by which Canadian fishing vessels were permitted to land their fares at American ports direct from the fishing grounds. Canadian vessels began to utilize this privilege in April, 1918. The arrangement was terminated by departmental order effective July 15, 1921.

Compared with the previous year, there was a decrease of 663 trips, or 8.01 per cent, in the total number landed at Boston, Gloucester, and Portland, and of 18,200,569 pounds, or 9.26 per cent, in the quantity, with an increase of \$678,630, or 8.99 per cent, in the value of the products landed. The only important species showing an increase in both quantity and value were halibut, mackerel, and swordfish. The catch of halibut increased 1,674,669 pounds, or 79.19 per cent, and \$254,630, or 91.59 per cent; the mackerel catch increased 1,580,525 pounds, or 27.66 per cent, and \$215,852, or 39.44 per cent; and the catch of swordfish increased 1,648,942 pounds, or 186.80 per cent, and \$281,834, or 132.71 per cent. The yield of cod decreased 3,108,838 pounds, or 4.75 per cent, but increased in value \$54,456, or 2.10 per cent; haddock decreased 7,436,768 pounds, or 8.99 per cent, and \$53,886, or 1.92 per cent; pollock decreased 10,191,066 pounds, or 54.34 per cent, and \$118,387, or 31.11 per cent; cusk decreased 208,459 pounds, or 10.10 per cent, and \$14,099, or 22.67 per cent; and herring decreased 3,361,901 pounds, or 32.45 per cent, and \$73,487, or 30.64 per cent. The output of bake increased 381,880 pounds, or 8.80 per cent, but decreased in value \$27,177, or 15.01 per cent. The Newfoundland herring fishery had a decline of 404,753 pounds, or 11.55 per cent, and \$79,626, or 41.95 per cent. There were no tilefish landed at Boston during the year. In the various other species combined there was an increase of 853,897 pounds, or 20.66 per cent, and of \$60,368, or 37.85 per cent.

The fishery products landed at Boston, Gloucester, and Portland by fishing vessels each year are taken principally from fishing grounds lying off the coast of the United States. In the calendar year 1920, 78.88 per cent of the quantity and 79 per cent of the value of the catch landed by American and Canadian fishing vessels were taken from these grounds: 3.35 per cent of the quantity and 4.63 per cent of the value, consisting largely of herring, from off the coast of Newfoundland; and 17.75 per cent of the quantity and 16.36 per cent of the value from fishing grounds off the Canadian Provinces. Newfoundland herring constituted 1.73 per cent of the quantity and 1.33

per cent of the value of the fishery products landed during the year. The herring were taken from the treaty coasts of Newfoundland and the cod, haddock, hake, halibut, and other species from that region were obtained from fishing banks on the high seas. All fish caught by American fishing vessels off the coast of the Canadian Provinces were from offshore fishing grounds.

Haddock ranked first in the New England vessel fisheries in 1920, with a catch of 75,279,477 pounds, valued at \$2,740,052. The yield of cod was 62,265,582 pounds, valued at \$2,637,637. There was unusual activity in the halibut fishery during the year. The catch of 3,789,330 pounds, valued at \$741,821, was the largest in five years. There was a large increase in the receipts of halibut at Portland, the catch in 1920 amounting to 1,159,973 pounds, the next largest in the past five years being 535,314 pounds in 1916. There has also been a noteworthy increase in the receipts of halibut at Boston in recent years but a decrease at Gloucester. The output of pollock was the smallest in many years, amounting to only 8,560,901 pounds, valued at \$262,128, as compared with 18,751,967 pounds, valued at \$380,515, in 1919, and 26,560,620 pounds, valued at \$962,085, in 1918. The hake product amounted to 4,721,356 pounds, valued at \$153,876, an increase of 381,880 pounds but a decrease of \$27,177, as compared with the previous year. The yield of this species has been comparatively small in recent years. The catch of other fish was as follows: Cusk, 1,854,739 pounds, valued at \$48,070; swordfish, 2,531,669 pounds, valued at \$494,202; flounders, 3,637,774 pounds, valued at \$166,895; and herring, 6,997,984 pounds, valued at \$166,301. The herring output included 3,900,960 pounds, valued at \$56,144, taken off the coast of the United States and landed fresh, and 3,097,024 pounds of salted Newfoundland herring, valued at \$110,157.

The mackerel fishery in 1920 yielded 79,799 barrels of fresh fish, compared with 53,992 barrels in 1919, and 4,897 barrels of salt fish, compared with 7,007 barrels in 1919. The value of the catch was \$671,310 for the fresh fish and \$91,784 for the salt fish, an increase of \$215,852 over the previous year. In 1921 the total yield of mackerel up to July 1 was 33,632 barrels fresh and 3,143 barrels salted, compared with 60,842 barrels of fresh and 3,357 barrels salted for the same period in 1920. In the southern mackerel fishery the purse-seine vessels had a poor season and the gill-net vessels had only fair success. The weather most of the time was unfavorable for fishing. The seiners reported seeing more fish in the South than for many years. The weather was good on the Cape Shore, and this fishery was comparatively successful, three vessels making second trips. The fish were caught mostly at night and in small schools. The fish averaged large, and the fresh sold from 6.60 to 16 cents per pound and the salted from \$12 to \$13.50 per barrel.

VESSEL FISHERIES AT SEATTLE, WASH.

The fishing fleet at Seattle, Wash., during the year 1920 brought in 822 fares, consisting of 14,355,450 pounds of fish, having a value to the fishermen of \$1,992,759, from the fishing grounds along the coast from Oregon to Alaska. The largest quantities were taken from Flattery Banks, off the west coast of Vancouver Island, and in

Hecate Strait. The products included 12,683,450 pounds of halibut, valued at \$1,913,849; 950,200 pounds of sablefish, valued at \$49,963; 513,035 pounds of "lingcod," valued at \$21,153; and 208,765 pounds of rockfishes, valued at \$7,794. Compared with the previous year, there was an increase of 152 trips landed and an increase of 704,430 pounds, or 5.16 per cent, in the quantity, and of \$462,475, or 30.22 per cent, in the value of the products. The yield of halibut increased 1,572,730 pounds, or 14.15 per cent, and \$491,330, or 34.53 per cent, but there was a decrease in the catch of other species. Sablefish, for which there was an augmented demand during the war period, decreased 603,400 pounds, or 38.83 per cent, and \$24,327, or 32.74 per cent; "lingcod" decreased 209,965 pounds, or 29.04 per cent, and \$3,280, or 13.42 per cent; and rockfishes decreased 54,935 pounds, or 20.83 per cent, and \$1,248, or 13.80 per cent.

The fishery products taken in Puget Sound and landed at Seattle by collecting vessels during the year aggregated 9,813,966 pounds, valued at \$881,066. This quantity included 7,911,820 pounds of salmon, valued at \$765,145, and the remainder consisted of herring, steelhead trout, smelt, rockfishes, flounders, crabs, and other species. Compared with the previous year, there was a net decrease in the products landed by collecting vessels of 1,995,484 pounds, or 16.89 per cent, and \$102,753, or 10.44 per cent, which decline was due to a large falling off in the catch of salmon. The decrease in salmon was, however, offset to some extent by a considerable increase in various less important species.

SHAD FISHERY OF THE HUDSON RIVER.

Figures gathered in a special canvass of the shad fishery of the Hudson River for 1920 indicated a reduction in the number of shad taken amounting to 40,986, or 45.38 per cent, and a diminished revenue to the fishermen amounting to \$27,415, or 32.74 per cent, compared with the season of 1919. The persons engaged in this fishery numbered 368, an increase of 69 over the previous year. The equipment included 185 rowboats, valued at \$10,911; 10 gasoline boats, valued at \$2,050; 200 gill nets, valued at \$23,710; 10 seines, valued at \$1,655; and shore and accessory property valued at \$2,925, the total investment being \$40,351.

The catch comprised 49,315 fish, or 199,844 pounds, valued at \$56,309, of which 39,692 fish, or 157,715 pounds, valued at \$43,882, were taken on the New York side of the river, and 9,623 shad, or 42,129 pounds, valued at \$12,427, were taken on the New Jersey side. The possibility of reestablishing a run of shad on a considerable scale in this river is still a matter of conjecture.

SHAD AND ALEWIFE FISHERIES OF THE POTOMAC RIVER.

The shad fishery of the Potomac River is of special interest to the Bureau owing to the long continuance of shad hatching operations thereon and the very active fishing that has been conducted in Chesapeake Bay. Statistics for the season of 1920 showed a catch of 529,358 shad, weighing 1,979,780 pounds, valued at \$334,464. The

number of fish taken was 15,111 less than in the previous year. Maryland fishermen are credited with only 80,944 shad, weighing 302,237 pounds and selling for \$55,963, as against 448,414 fish, weighing 1,677,543 pounds and valued at \$278,501, taken by Virginia fishermen.

The production of alewives or river herrings was 8,759,336 fish, or 4,352,668 pounds, valued at \$55,137, of which 7,681,561 fish, weighing 3,813,780 pounds and having a value of \$41,197, were taken by Virginia fishermen.

The combined fisheries for shad and alewives gave employment to 753 persons, who used 451 boats, valued at \$83,889; 271 pound nets, valued at \$126,455; 211 gill nets and one haul seine, valued at \$39,620; and shore and accessory property worth \$1,375.

THE FROZEN-FISH TRADE.

* From compilations made from the monthly memoranda issued by the Bureau of Markets it appears that fish frozen between January 15, 1920, and January 15, 1921, aggregated 85,324,366 pounds. The quantity of halibut frozen was 10,625,029 pounds; herring, 10,356,305 pounds; whiting, 10,208,755 pounds; salmon, 7,836,620 pounds; ciscoes, 6,968,750 pounds; mackerel, 4,835,173 pounds; cod, haddock, lake, and pollock, 3,940,163 pounds; and squid, 3,252,720 pounds, with smaller amounts of other species. The maximum quantity in storage at one time during the year, amounting to 67,827,934 pounds, was reported on November 15, and the minimum, amounting to 20,284,470 pounds, on May 15, 1920. A study of the data over a period of several years indicates that the storage peak is reached about November 15 and the low point between April 15 and May 15 of each year.

FISHERIES OF THE SOUTH ATLANTIC STATES.

Tabulated returns of the statistical canvass of the fisheries of the South Atlantic States concluded by the Bureau in 1920 indicate that in 1918 the industry gave employment to 15,046 persons, of whom 8,036 were credited to North Carolina, 2,000 to South Carolina, 1,680 to Georgia, and 3,330 to eastern Florida. Compared with the returns for 1902, there was a decrease of 8,406, or 35.84 per cent. The capital invested was \$7,423,971, distributed as follows: North Carolina, \$4,222,043; South Carolina, \$221,251; Georgia, \$769,998; and eastern Florida, \$2,210,679. Compared with 1902, there was increase of \$4,432,822, or 148.19 per cent. The principal forms of apparatus employed in the fisheries were pound nets, gill nets, purse seines, haul seines, and otter trawls, the last-named device having been introduced in the shrimp fisheries about 1915.

The products of the fisheries aggregated 332,614,123 pounds, with a value to the fishermen of \$5,348,616, distributed among the several States as follows: North Carolina, 210,501,750 pounds, \$2,978,708; South Carolina, 3,746,932 pounds, \$207,690; Georgia, 37,153,953 pounds, \$416,043; and eastern Florida, 81,211,488 pounds, \$1,746,175. Some of the more abundant species arranged in order of size of catch were: Menhaden, 257,757,799 pounds, valued at \$1,605,117; shrimp, 15,656,903 pounds, valued at \$470,346; alewives, fresh and

salted, taken mostly in North Carolina, 15,185,585 pounds, valued at \$412,067; mullet, fresh and salted, 11,757,318 pounds, valued at \$508,044; oysters, 5,871,376 pounds, or 838,768 bushels, valued at \$260,863; squeteagues or sea trouts, 5,105,249 pounds, valued at \$360,527; Spanish mackerel, taken mostly in Florida, 3,211,405 pounds, valued at \$232,355; cero and kingfish, credited mostly to Florida, 2,483,647 pounds, valued at \$161,562, and spot, 1,692,775 pounds, valued at \$72,795. As compared with the Bureau's returns for 1902, there was increase in the catch aggregating 226,168,051 pounds, valued at \$2,508,983. The large advance over previous years was mostly due to the greatly increased output of menhaden, the 1902 catch amounting to only 18,862,000 pounds, as against 257,757,799 pounds in 1918. The yield of all other species in 1902 was 87,584,072 pounds and in 1918, 74,856,324 pounds. Other products which have shown a noteworthy increase are cero and kingfish, drums, Spanish mackerel, and shrimp.

FISHERIES OF THE NEW ENGLAND STATES.

A canvass of the fisheries of the New England States for the calendar year 1919 was completed early in 1921. The number of persons ascertained to be engaged in the fisheries was 30,767, credited to the different States as follows: Maine, 14,386; Massachusetts, 12,346; Connecticut, 2,289; Rhode Island, 1,646; and New Hampshire, 100. Compared with the returns for 1905, there has been a decrease in the number of persons employed of 6,572, or 17.60 per cent. The investment in the fisheries of the different States arranged in the order of importance was as follows: Massachusetts \$19,111,269; Maine, \$17,544,969; Rhode Island, \$2,249,536; Connecticut, \$1,645,793; New Hampshire, \$45,530; total, \$40,597,097. This represents an increase of \$18,066,377, or 80.18 per cent, as compared with 1905.

The yield for the region amounted to 467,339,870 pounds, valued at \$19,838,657, distributed as follows: Massachusetts, 246,951,241 pounds, valued at \$10,859,746; Maine, 147,956,369 pounds, valued at \$3,889,035; Rhode Island, 48,250,883 pounds, valued at \$3,296,578; Connecticut, 23,652,647 pounds, valued at \$1,700,638; and New Hampshire, 528,730 pounds, valued at \$92,660. The most important products were: Cod, 84,917,535 pounds, valued at \$3,597,891; oysters, 19,337,374 pounds, or 2,762,482 bushels, valued at \$2,617,020; lobsters, 10,666,706 pounds, valued at \$2,550,980; haddock, 89,405,609 pounds, valued at \$2,544,617; and mackerel, 15,785,012 pounds, valued at \$1,562,088. Compared with 1905, there was a net decrease amounting to 12,943,734 pounds, but a net increase of \$5,654,452 in the first value of the products.

SARDINE INDUSTRY OF MAINE.

A complete enumeration of the sardine industry of the State of Maine was made by the Bureau for the calendar years 1919 and 1920. In 1919 the plants engaged in canning sardines numbered 53. The herring utilized amounted to 125,309,415 pounds, valued at \$852,450, and the pack of canned fish was 2,450,268 cases, valued at \$11,933,986, of which 1,902,430 cases, valued at \$9,327,665, were quarter oils. In 1920 the plants numbered 50 and the herring consumed aggregated

104,700,010 pounds, valued at \$767,141. The total pack was 1,877,757 cases, valued at \$7,435,056, of which 1,458,670 cases, valued at \$5,669,352, were quarter oils.

FLORIDA SPONGE FISHERY.

The sponge-inspection service, to make effective the law regulating the size of commercial sponges taken from waters off the Florida coast and landed at American ports, has been kept up throughout the year. The Florida sponge fishery appears to be maintaining a satisfactory equilibrium between the natural supply and the catch. It is regrettable that large quantities of small sponges barely meeting legal requirements continue to be taken. In the previous report attention was called to the large profit to be obtained if the small sponges were permitted an additional year's growth. This seems to have been demonstrated during the year by the quantity of large sponges taken on certain bars that had not been fished for several years. The continued demand for the larger sizes has somewhat encouraged the spongers to work in deeper water, say, from 9 to 12 fathoms. If a period of rest and recuperation for the shallower bars can be secured for a reasonable period, the sponge fishery as a whole will be greatly benefited.

The fishery has not escaped the fluctuations in value and general depression felt in other industries. The radical changes in price throughout the year, with considerable quantities of sponges remaining unsold from time to time, have not tended to simplify the financing of operations, but with a gradually improving market and the high quality maintained in the sponges taken the future may be viewed without concern.

INCREASED USEFULNESS TO THE FISHERIES.

The Bureau has recently been extending to the fishing industry a larger service than ever before, but it falls short of the opportunities and has been unable to meet various obligations that naturally devolve on the sole Federal agency charged by law with the duty of aiding the fisheries.

With due regard for the utmost economy in governmental expenditures, and having in view the efforts which the industry should undertake on its own behalf, there has existed and still exists a real need for additional Federal aid to the fisheries such as the Bureau is able to render but which it can not undertake with its present facilities. In an industry yielding an annual harvest of 2,500,000,000 pounds of products it is highly important from the standpoint of national welfare that the aquatic resources be utilized to the best advantage, and the Government would be amply justified in greatly increasing the appropriations that are available for such a purpose.

Some of the technological work that the Bureau felt should be undertaken in behalf of the fisheries has been indicated in estimates of appropriations that have been submitted to Congress in recent years and in special bills on which the Department has made favorable reports. At the present time an appeal is being made for an increase in the general funds for maintaining the division charged

by law with duty toward the fisheries, to the end that the unique fishery-products laboratory in Washington and the temporary laboratory on the California coast be operated for the solution of various technological problems, that statistical canvasses showing the condition and trend of the fisheries may be prosecuted more frequently and more promptly, and that numerous field inquiries and investigations concerned with methods of taking, handling, preserving, and marketing fishery products may be carried on. A special appropriation is requested for the conduct of investigations in the development and standardization of methods of preservation of Pacific coast fishes.

When provision is made for enlarged investigations of wider scope, there will be required also such a readjustment of salaries as will enable the Bureau to secure and retain the services of persons properly qualified in the various branches and for an increased personnel that will include an assistant in fishery trade practices, three fishery technologists, a technical machinist capable of operating and caring for the highly specialized equipment of the fishery-products laboratory, and at least three additional statistical agents.

ALASKA FISHERIES SERVICE.

EXTENT OF THE ALASKA FISHERIES.

The 1920 salmon season had as its outstanding features a diminished catch in southeast Alaska and an increased catch in central and western Alaska as compared with 1919; an increase in the number of canneries operated but an output of canned fish that was less than in each of the five preceding years; a decline in the business in mild-cured, pickled, and fresh salmon; and a very dull market for canned salmon, especially the cheaper grades, many lots of which were sold for less than the cost of production.

The salmon taken in the Alaska fisheries in 1920 numbered 65,080,539 fish, of which 32,112,611 were humpback or pink salmon, 20,187,925 red or sockeye salmon, 10,113,677 chum or dog salmon, 1,890,859 coho or silver salmon, and 775,467 king or spring salmon. Apportioned by geographical districts the catch in southeast Alaska was 33,096,640 fish, central Alaska 19,574,332 fish, and western Alaska, 12,409,567 fish. Comparing these figures with the returns for 1919, it appears that there was a net increase of about 12 per cent; coho, chum, and king salmon were taken in less numbers and humpback and red salmon in greater numbers.

The canneries, which consumed the principal part of the salmon catch, numbered 146, an increase of 12 over 1919. The pack of canned fish was 4,429,463 cases, with a market value of \$35,602,800, a decrease of 154,225 cases and \$7,662,549 from the previous year. The pack both of red and king salmon was larger and that of the other species was smaller than in 1919.

Other salmon products were 1,857,800 pounds of mild-cured fish, valued at \$364,219; 964,400 pounds of pickled fish, valued at \$104,873; 1,916,595 pounds of frozen fish, valued at \$161,143; 3,248,081 pounds of fresh fish, valued at \$263,261; 244,840 pounds of dry-salted, dried, and smoked fish, valued at \$40,785; 39,052 gallons of oil, valued at \$16,370; and 1,778,000 pounds of fertilizer, valued at \$88,382; giving

\$36,641,880 as the total value of the products of the Alaska salmon industry in 1920.

The halibut fishery ranks next to the salmon fishery, and in 1920 yielded 7,506,703 pounds of fresh fish, valued at \$1,034,380; 7,788,017 pounds of frozen fish, valued at \$622,343; and 720 pounds of canned fish, valued at \$75.

Products of the herring fishery consisted of 8,223,490 pounds of Scotch-cure fish, valued at \$490,485; 344,019 pounds of Norwegian-cure fish, valued at \$22,199; 3,602 cases of 1-pound cans, valued at \$28,380; 681,067 gallons of oil, valued at \$404,090; and miscellaneous commodities, valued at \$357,860.

The cod fishery yielded a catch valued at \$1,117,464. The products of the shore whale fishery had a value of \$562,302. Minor items were: Clams, \$40,812; crabs, \$1,740; shrimps, \$49,123; trout, \$18,002; sable-fish, \$28,544; and miscellaneous fresh fish, \$229.

The entire Alaska fishing industry, exclusive of fur sealing, gave employment to 27,482 persons, represented an investment of \$70,-980,221, and yielded products valued at \$41,492,124.

A detailed account of the extent and condition of the Alaska fisheries in 1920 and of the activities of the Bureau under the laws and regulations for the protection of the fisheries is embodied in the annual report of the Alaska service for that year.¹

ENFORCEMENT OF FISHERY LAWS AND REGULATIONS.

During the fishing season of 1920 the Bureau had in service for patrol purposes 13 vessels, and the same number was available in 1921. For the 1921 season the persons engaged in connection with the enforcement of laws and regulations numbered 63, of whom 23 were regular and 40 were temporary employees.

A number of violations of the fishery laws were detected and successful prosecutions were made in the local courts. The Bureau is doing its utmost, however, to prevent violations by maintaining watchmen or guards at the mouths of salmon streams throughout the fishing season. In some instances the stream guards, being equipped with small power boats, are able to look after two or three streams so close together that their absence from any one stream will not be so protracted as to permit illegal fishing within the stream or inside the protected area at its mouth. It is the policy to discourage and prevent violations, for thereby not only are the expense and annoyance of prosecution avoided but, what is of greater importance, the salmon which would have been killed through such illegal fishing are permitted to proceed to the spawning grounds. The extension of the stream-watchmen system will be made as fast as funds are available and should soon embrace every important salmon stream.

Attention has been devoted during the year to the erection of additional markers near the mouths of salmon streams to give fishermen notice as to the limits of the areas in which salmon fishing is prohibited. Suitably inscribed cloth notices have been posted conspicuously, and thus far upwards of 200 of the more important salmon streams have been marked.

¹ Alaska Fisheries and Fur-Seal Industries in 1920, by Ward T. Brown, sixth Alaska service (Bureau of Fisheries Doc. No. 566).

The systematic stealing of salmon from fish traps in southeastern Alaska was renewed during the 1920 fishing season but was less extensive than in 1919. Some of the cannery owners augmented their force of watchmen and detailed fast boats to the special duty of protecting their traps from these marauders. It would seem that one of the most certain and effective methods of bringing this nefarious practice to an end would be for cannerymen or other purchasers of salmon to establish definitely the source of fish offered for sale by independent boats. The suppression of this practice does not fall within the functions of the Bureau.

Detailed instructions issued to the Bureau's employees in Alaska on May 25, 1921, prescribed methods of observance of the close season for fixed fishing apparatus and the proper labeling of all apparatus, also the procedure to be followed in inspecting such apparatus and in reporting and prosecuting violations of the laws and regulations.

PRIVATE SALMON HATCHERIES.

The private salmon hatcheries in Alaska have been inspected, as required by law. In 1921 two such hatcheries were operated. One of these, on Naha Stream, liberated 17,375,000 red salmon fry in the fiscal year 1921, and the other, located on Hugh Smith Lake, liberated 18,913,000 red salmon fry in the same period. The total rebate of taxes on canned salmon, at the rate of 40 cents a thousand fry released by these hatcheries, amounted to \$14,515.20.

NEW SALMON-FISHERY REGULATIONS.

In accordance with announcements duly issued, hearings were held at Cordova on October 5 and at Seattle on November 18, 23, and 30, and December 3, 1920, for the consideration of necessary changes in the regulations regarding salmon fishing in Alaska. The waters affected are southeastern Alaska, the region between Cape Spencer and Cape Newenham, including Bering and Copper Rivers, and the Kuskokwim and Yukon Rivers. As a result of these hearings the following order was issued on December 18, 1920:

Hearings having been given, after due notice in accordance with law, for the purpose of determining the advisability of limiting or prohibiting fishing in certain waters in Alaska, and to amend or modify certain existing regulations, and all persons having had full opportunity to be heard, it is hereby ordered, by virtue of the authority vested in me by section 6 of "An act for the protection and regulation of the fisheries of Alaska," approved June 26, 1906, that until further notice all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in all herein-after-described waters of Alaska be, and is hereby, made subject to the following limitations and prohibitions in addition to the general restrictions already applicable by virtue of existing laws and regulations.

1. Waters east of the longitude of Cape Spencer:

(a) All fishing is prohibited in all salmon streams and their tributaries and lakes.

(b) All fishing, except with purse seines and drift gill nets, is prohibited within 500 yards of the mouths of all salmon streams.

(c) All fishing with purse seines and drift gill nets is prohibited within 200 yards of the mouths of all salmon streams, and all fishing with purse seines and drift gill nets, as well as with all other apparatus, is prohibited within 500 yards of the mouths of Chilkat River, Chilkoot River, Anan Creek, Hetta Creek, Sockeye Creek, and Naha Stream.

2. All fishing is prohibited in all salmon streams, their tributaries and lakes and within 500 yards of the mouths of such streams flowing into the Pacific Ocean or Bering Sea between Cape Spencer and Cape Newenham, except as follows:

(a) Fishing is permitted in Copper River and its tributaries in accordance with the terms of the order promulgated December 20, 1918, which order is continued in full force until September 1, 1921, upon which date said order of December 20, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Copper River, its tributaries and lakes, and within 500 yards of each mouth of the Copper River is prohibited.

(b) Fishing is permitted at Karluk beyond the zone 100 yards outside the mouth of Karluk River where it breaks through Karluk Spit into Shelikof Strait.

(c) Fishing is permitted in Ugashik River below a line extending at right angles across the Ugashik 500 yards below the mouth of King Salmon River.

3. On and after September 1, 1921, all fishing is prohibited in the Kuskokwim River, its tributaries and lakes, and within 500 yards of the mouth of the Kuskokwim for other than local use in Alaska.

4. Fishing is permitted in the Yukon River and its tributaries in accordance with the terms of the order promulgated December 14, 1918, which order is continued in full force until September 1, 1921, on which date said order of December 14, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Yukon River, its tributaries and lakes, and within 500 yards of each mouth of the Yukon is prohibited for other than local use in Alaska.

5. The driving of salmon downstream and the causing of salmon to go outside the protected area at the mouth of any salmon stream are expressly prohibited.

6. This order does not apply to persons taking salmon with rod, hand line, or spear for their personal or family use and not for sale or barter.

7. The waters of the Afognak Reservation are covered by presidential proclamation of December 24, 1892, and the regulations promulgated by authority thereof are not modified or affected by this order, but remain in full force.

8. All previous orders of the Secretary of Commerce imposing limitations or prohibitions upon fishing in the waters covered by this order, except as hereinbefore indicated, are hereby superseded.

9. This order becomes effective January 1, 1921.

Announcement has been made of hearings to be held in the fall of 1921, as follows: Juneau, Alaska, October 19. and Seattle, November 15, to consider further restrictions on commercial fishing in waters of southeastern Alaska, and at Seattle, November 17, in regard to waters of western and northern Alaska.

In submitting to the Secretary of Commerce recommendations for the protection and maintenance of the salmon resources of Alaska, the Bureau is guided largely by the personal knowledge of conditions possessed by its staff of assistants regularly employed in Alaska or detailed thereto for special duty. The data that are considered cover both the practical aspects of the fishery and the biological situation as regards the salmon in given waters, and the established policy is to impose no greater restrictions on the fishery than are believed to be required for the perpetuation of the industry. In recent years very important and far-reaching investigations of the habits, age, growth, spawning grounds, etc., of the different species of salmon in different streams have been in progress, and the Bureau has been fortunate in retaining for this work the services of the leading authority on the Pacific salmons.

PROTECTION OF WALRUS AND SEA LION.

Pursuant to the provisions of the act of May 31, 1920, which transferred to the Department of Commerce the jurisdiction heretofore exercised by the Department of Agriculture with respect to the walrus and the sea lion in Alaska, the Secretary of Commerce approved a new set of regulations governing the killing of these animals within the territorial limits of Alaska, and in a circular issued under date of April 21, 1921, promulgated the regulations and quoted from the Alaska game law approved May 11, 1908, extracts in regard to the walrus and the sea lion. The new regulations are as follows:

WALRUSES.

1. The killing of walruses for their tusks or hides, or both, is prohibited as being wanton destruction within the meaning of the act of May 11, 1908.

2. The killing of walruses at their breeding places in Alaska is prohibited at all times.

3. The killing of walruses throughout the territorial limits of Alaska is prohibited from May 1, 1921, to April 30, 1923, both dates included, except by natives for food or clothing or by miners or explorers when in need of food.

SEA LIONS.

1. The killing of sea lions on their rookeries or hauling-out grounds is prohibited at all times.

2. The killing of sea lions is prohibited from May 1, 1921, to April 30, 1923, except by natives for food or clothing, or by miners or explorers when in need of food, or by anyone in the necessary protection of property, or while such animals are actually engaged in the devastation of runs of salmon. The killing of sea lions under any other circumstances than the foregoing will be deemed wanton destruction and punishable as a violation of this order.

NEW LEGISLATION NEEDED.

The act of June 26, 1906, which provides for the regulation and protection of the fisheries of Alaska, is obsolete in some of its features and in general is quite inadequate to meet the conditions that have existed for a number of years. The law is practically restricted to the salmon fishery, which, under its operation, has become so extensive that the salmon supply in certain waters has been seriously depleted and the future welfare of the industry and of the Territory is jeopardized. The law imposes no limit on the number of canneries and salteries that may be established and operated, the number of fixed and floating traps that may be constructed, the number of purse seines, haul seines, set and drift nets that may be used, the number of trolling boats and trolling lines that may be employed, the number and age of salmon that may be caught. Various restrictive features of the law have long since proved ineffective to prevent the capture of an undue proportion of the run of salmon in certain waters, and fishing operations in full compliance with law may be entirely incompatible with the welfare of the fishery.

One of the most serious defects of the law is its failure to give sufficient protection to salmon off the mouths of spawning streams. The maximum distance from the mouth of a stream to which the jurisdiction of the Department extends is 500 yards. It is entirely

feasible to conduct fishing operations with various kinds of gear so actively beyond the restricted zone as to offset the effects of the protection afforded the salmon in streams and immediately off their mouth, and this, in fact, is occurring in various localities. A measure designed to meet this situation and furnish this limited relief pending the enactment of a new general fish law for Alaska is the bill (H. R. 2394) which confers on the Secretary of Commerce jurisdiction over the fisheries for a distance of 3 miles off the mouth of any stream in Alaska and authorizes him to prescribe for such area the regulations deemed by him necessary or desirable to perpetuate the salmon supply. The bill, which has received the indorsement of the Department, has been favorably reported by the House Committee on the Merchant Marine and Fisheries and is now on the calendar.

The present law has no application to whales, crabs, shrimp, clams, and various other valuable products, and the taking of such animals is permitted without any restriction whatever. In the absence of any protection very extensive and valuable clam beds in central Alaska have been depleted, and other instances of the kind might be cited.

FUTURE DEVELOPMENT OF ALASKA FISHERIES.

While the salmon and halibut fisheries of Alaska will undoubtedly hold a dominant place for many years, the greatest development of the fishing industry is to be expected in other branches, particularly in the increased attention given to cod and herring, and ultimately to certain minor resources which are now almost untouched but which in the aggregate constitute a potential source of food and wealth that will mean much to the future welfare of Alaska. The herring supply of Alaska is possibly unsurpassed anywhere in the world, and there may be anticipated such a growth in herring fishing and herring curing that a formidable rival of the salmon industry may arise. Vast expanses of water in all parts of Alaska abound with bottom food fishes of a kind in good demand in other parts of the world, but their surface has remained practically unbroken by the boats of fishermen equipped to take such fishes. Substantial development may be expected also in the crab and shrimp fisheries. The Alaska shrimps are not surpassed elsewhere in size and quality and are undoubtedly destined to enter largely into commerce in a fresh, frozen, and canned condition.

CONTROL OVER THE ALASKA FISHERIES.

There has been the usual agitation for the transfer to the Territory of Alaska of the control over the aquatic and other natural resources that has heretofore been exercised by the Federal Government. The desire for this change of jurisdiction, while not entertained by a conspicuously large number of the representative people of the Territory, is a legitimate aspiration of those who hope to see Alaska soon take her place as a sovereign State. As regards the fisheries, the feeling is quite generally prevalent among those having property interests that the time is not yet ripe for the assumption of the responsibilities of statehood.

While constantly dwelling on real and imaginary defects of the fishery administration, it is a fact that interests ostensibly friendly

to Alaska have successfully opposed all efforts on the part of the Department to have Congress give to Alaska a new fishery code adapted to the needs of the industry and have prevented the passage by Congress of constructive measures that have received favorable action in committee after protracted hearings.

It is the well-known desire of the Department to give to Alaska the most direct administration of the fisheries compatible with the requirements of law, and a large measure of independent action has been vested in the responsible representatives in various parts of the Territory. As a matter of fact, the fisheries of Alaska are now administered largely without reference to the Washington office, and the criticism properly made about the attempts at long-range control does not apply. With the exception of the power of appointment to statutory positions which is vested in the Secretary of Commerce, and the interpretation of questions of law which is vested in the Department of Justice, practically full authority without recourse to Washington is reposed in the Department's agents charged with the protection of the fisheries of Alaska. Of the 63 persons employed in the enforcement of law and regulation for the protection of the Alaska fisheries in 1921, 40 were regular residents of Alaska. An even larger proportion of appointments from Alaska would be made if suitable persons could be secured at the salaries that are available.

ALASKA FUR-SEAL SERVICE.

GENERAL ACTIVITIES AT THE PRIBILOF ISLANDS.

The administration of the Pribilof Islands, with their dependent native inhabitants and with their valuable herds of fur seals and blue foxes, is one of the most important duties devolving on the Bureau. The material interests of the Government arise from international relations having to do with the utilization of the fur seals and from the fact that the annual return from the islands is more than a million dollars.

The affairs of the Government on the Pribilofs are managed by a staff of about 15 white people, augmented by more than 300 natives. These natives, the descendants of Aleuts taken to the islands by the Russians more than a century ago, are undoubtedly as well cared for as any other native people in Alaska. They are furnished food, fuel, clothing, shelter, and other necessities, and have the benefit of schools and competent medical supervision. In return they perform most of the labor involved in taking and caring for the valuable products of the islands and in maintaining the Government plants. They receive cash remuneration in proportion to the amount and grade of service rendered. In recent years the local force of able-bodied natives has been supplemented during the few weeks of the active sealing season by 30 native laborers from the Aleutian Islands.

In 1920 a dentist was engaged to spend a few months at the Pribilof Islands. An excellent start was made in this much-needed field, for which special provision had never before been made. In order to continue the work thus inaugurated a dentist was sent to the Pribilofs in the summer of 1921; he will remain through the winter or until such time as his services are no longer required.

The important problem of housing the natives has received attention, and improvements in the native dwellings on St. Paul Island will be made as funds are available. One additional dwelling on St. Paul Island was completed and occupied during the past year. School buildings and dwellings were repaired, a new shop and warehouse was built on St. George Island, extensions to the salt houses were made on St. Paul Island, additional roadwork was undertaken, and, in conjunction with the Navy Department, preliminary work in drilling an artesian well was done. The by-products plant on St. Paul Island was operated, and 8,759 pounds of seal meal and 5,271 gallons of various grades of oil were produced.

The Bureau's vessel *Eider* has given valuable service in transportation of supplies and persons between Unalaska and the Pribilof Islands, and also made trips to King Cove and Kodiak. While returning from the latter place in December, the *Eider* rendered noteworthy assistance in locating at Chignik the disabled mail boat *Pulitzer*, long overdue, whose passengers, crew, and mail were taken to Unga. Credit is due the master and crew of the *Eider* for this work, as well as for other hazardous voyages during the winter to the Pribilof Islands.

Acknowledgment is made of courtesies extended by the Navy Department in the transportation of supplies and passengers on the *Saturn* from Seattle to the Pribilof Islands and in carrying seal-skins and fox skins on the return voyage of that vessel. The operation of the radio stations on St. Paul and St. George Islands has been of great value to the Bureau. The Bureau is also pleased to acknowledge numerous courtesies by the Coast Guard in the transportation of personnel and supplies upon vessels of that service.

THE SEAL HERD.

The 1920 census of the seal herd, taken as of date of August 10, indicated 552,718 animals of all ages, an increase of 28,483 over 1919. The census for 1921 gave 587,820 animals on the same date, an increase of about 35,000. The number of pups born in 1921 was 176,655. The seals killed from one census date to the next are not included in these figures. The 1920 enumeration was made by Dr. G. Dallas Hanna, who had been in charge of this work for several years; the 1921 census was placed under Edward C. Johnston, who had participated in the work of the previous year.

An innovation connected with the census in 1921 was the construction of two runways 6 feet above the ground leading to observation towers on one of the large rookeries on St. Paul Island, where in former years much difficulty and danger were experienced in making accurate observations on the large number of massed seals. To further facilitate the census, a number of concrete markers were prepared and placed on the rookeries at important points.

The average number of cows per harem in 1920 was 41; in 1921 the average was 45. These figures are regarded as indicating a very satisfactory condition of the herd.

In order that the Bureau might have the views and counsel of persons familiar with the fur-seal herd, an important conference was held in Washington on January 10, 1921, at which there were dis-

cussed methods and results of the seal census, the quota of 1921 and subsequent years, the length of the seal-killing season, etc. It was the sentiment of the conference that representatives of the interested nations should visit the Alaskan, Japanese, and Russian seal islands at an early date.

In June, 1921, a representative of the Bureau authenticated at Sitka 199 fur-seal skins legally taken by natives in the spring of this year, when the seal herd was migrating northward. A patrol of the sealing grounds was maintained by the Bureau's vessels *Murre* and *Auklet* in the latter part of May, while the herd was in that vicinity.

THE TAKE OF SEALSKINS.

The number of seals killed under governmental supervision on the Pribilof Islands in 1920 was 26,648, of which 25,978 were taken during the regular season ending on August 10 and the remainder in fall and winter for the food purposes of the natives. Seals 3 and 4 years old yielded 25,297 of the total skins secured.

The quota of seals to be killed during the calendar year 1921 was tentatively fixed at 30,000. The first drives were made in June, and the season closed on August 5, five days earlier than usual, to avoid the risk of killing cows which about that time began to resort to the hauling grounds of the bachelor seals. The seals taken numbered 22,546, mostly 3 years of age. The usual fall killing, beginning October 20, will add some hundreds to the skins available for sale.

As a result of extensive experimental work in 1920 certain innovations and improvements in the taking and handling of fur-seal skins were developed and put into effect along practical lines in 1921. It was found that the highest grade of finished product could be secured by removing the pelt from the carcass with the least possible use of the knives, thus practically eliminating all cuts or flays on the underside of the pelt previously unavoidable at times even by the most skillful skimmers. This was accomplished by suspending the seal from a tripod, cuts being made around the flippers, head, and down the abdomen, and the skin then being simply stripped off the carcass. In continuance of the new methods, the skins are then blubbered and washed in sea water before salting, the experiments last season having shown the great advantage of washing the pelts. An improved method of spreading and stretching them at the time of salting has also been tried. By another year it is contemplated that all skins will be taken in accordance with the new and improved processes, for which special facilities have had to be provided.

SALE OF SEALSKINS.

In the fiscal year 1921 two public auction sales of fur-seal skins were held at St. Louis. At the sale on February 21, 1921, 10,120 skins brought \$355,689, and on May 23, 1921, 10,060 skins were sold for \$359,715, a total of \$715,404. The lower prices received reflected the general depression in the fur markets of the world.

At the sale on February 21, 1921, there were also sold 111 sealskins from the Japanese herd on Robben Island, representing the share of the United States in the skins taken in the years 1918 and 1919. The 111 skins brought \$3,434.

As a net result of the sales of fur-seal skins in the fiscal year 1921 there will have been deposited in the Treasury of the United States the sum of \$341,543.46. In addition to this amount the sum of \$123,058.42 has been set aside for payment to Great Britain and Japan as their share of skins to which they are entitled under the North Pacific Sealing Convention of 1911.

FOXES AND REINDEER.

A valuable natural asset on the Pribilof Islands are the herds of blue foxes. The animals have to be held in check, and the taking of a certain number of pelts each winter is desirable. Under the plan in effect on St. George Island, involving the systematic feeding of the foxes during the winter on preserved seal carcasses, the herd has increased steadily and further improvement may be expected.

The foxing operations in the winter of 1920-21 were most satisfactory. Blue foxes to the number of 1,125 were taken for their skins, together with 14 foxes in the white phase. This is the largest number of foxes taken since 1892-93, when 1,301 skins were reported by the lessees of the islands.

During the past winter 240 pairs of the best blue foxes entering the large trapping inclosure on St. George Island were released as breeders.

The fox skins taken in the season of 1919-20, numbering 901 blues and 37 whites, were sold at public auction in St. Louis on February 21, 1921. The price realized was \$80,699, an average of \$88.12 for blues and \$35 for whites.

The introduction of reindeer on the Pribilof Islands in 1911 has proved very successful. The original stock consisted of 40 animals. The most recent computation indicated 192 on St. Paul Island and 125 on St. George Island, or 34 more than the number reported for the previous year. These figures do not include 53 animals used for food purposes during the intervening period. The herds are becoming more and more valuable as a splendid source of fresh meat for both the whites and natives.

MISCELLANEOUS.

SEMICENTENNIAL OF THE BUREAU.

The Bureau of Fisheries attained the fiftieth year of its existence on February 9, 1921, having had its origin in a joint resolution passed by Congress on February 9, 1871.

At the time of its establishment, and for many years thereafter, the Bureau was an independent commission and its duties were largely investigatory. Scientific investigation, the initial function imposed on the service by law, has remained a prominent branch of the work, recognized as an essential aid to fish culture and the fisheries. From time to time in the early years Congress imposed new responsibilities and duties, and the growth was rapid. The collection of statistics of the commercial fisheries, which was undertaken at an early date to meet a pressing national need, soon expanded into a comprehensive study of all phases of the fisheries which reached a high degree of progress in the second decade of the

Bureau's existence, and in more recent years has been extended and amplified, with a view to supplying practical aid to the fishing industry.

The early investigations of the food-fish resources of the coastal and interior waters of the country, undertaken in response to acts of Congress, convinced the first Commissioner that, with the control and regulation of the fisheries vested in the various States, an important rôle for the Federal Government to play in the maintenance of those resources was in the field of artificial propagation. This soon became the most extensive branch of the service, and has continued to employ the most people and receive the largest appropriations, but in the organization and administration of the Bureau fish culture has never been more than a coordinate division of the work. In 1910 there was imposed on the Bureau for the first time responsibility for the administration of protective laws, when the fishes and fur seals of Alaska were transferred to its custody.

The early operations of the Bureau attracted to its service an able corps of men who became pioneers in various branches of fish culture, aquatic biology, and fishery technology, and who gave to the work a trend and character which have continued to serve as a guide.

As evidence of the scope and character of the Bureau's activities during the 50 years of its existence, there has been issued an analytical subject bibliography of its publications from 1871 to 1920, inclusive. This document lists many thousand separate titles covering the fisheries, fish culture, aquatic biology and physics, oceanography, fishery legislation and protection, etc., constituting the most extensive series of reports in this field ever published.

NEW BUILDINGS AND IMPROVEMENTS.

A very satisfactory new fireproof building has been constructed at the Woods Hole (Mass.) station, under a contract awarded January 6, 1921, for \$51,000. The new structure replaces a storehouse and machine shop destroyed by fire and an old boiler house and pump house which had become so permeated with dry rot that it had to be demolished. From the special appropriation provided for this purpose the equipment, machinery, and stores consumed by the fire have been replaced, a salt-water filter has been provided, and various other improvements have been brought about.

The balance of the special appropriation for the Bozeman (Mont.) station after the repairing of the superintendent's residence was used for the purchase and erection of a bungalow for the foreman containing five rooms, a cellar, and a spacious attic.

The new laboratory building of the fisheries biological station at Fairport, Iowa, has been completed and equipped and has been actively used for the purposes for which the station was established. Formal acceptance of the building from the architect and its dedication to the service of the fisheries occurred on October 7, 1920. The structure, which replaces a frame building destroyed by fire in 1917, is of concrete, stone, and brick, is about 100 by 50 feet, with three stories and basement, and is superior to the old building in respect to capacity, convenience, and serviceability. The normal ac-

commodations for 16 investigators may be increased as circumstances demand. Among the useful features are a library, a chemical laboratory, a photographic room, a museum, a mess hall and kitchen, and tank and aquarium rooms, in addition to offices.

At the beginning of the year reconstruction work at the Baker Lake (Wash.) station was well under way, and though hampered by difficulties in transportation and by high prices of material and labor has progressed to a point where the station is again on an efficient working basis. In addition to the hatchery described in the last report a bunk house, sawmill, and workshop have been erected, all of which are of frame construction with iron roofs. Practically all the tools and appliances, including nets, seines, hatchery equipment, and furniture of all kinds, were destroyed and have been replaced. Communication with Baker Lake station is by means of pack horses over an 18-mile trail, and the large amount of heavy material needed in the reconstruction of the plant has made it necessary to undertake considerable improvements to the trail, including the rebuilding of bridges, corduroy work over swampy portions, and grading at other points.

The construction work at the Yes Bay (Alaska) station has included the installation of a new water-supply system, the main line consisting of about 4,000 feet of 16-inch and 18-inch wood-stave pipe for conveying water to the hatchery and ponds, with 1,250 feet of 6-inch pipe to supply water for domestic use and fire protection. New foundation timbers have been laid under the hatchery, the worn-out floors of the building have been replaced with new ones, 240 hatching troughs and a 196-foot supply trough have been constructed, and important repairs have been made to other buildings and equipment.

VESSEL SERVICE.

Owing to the Bureau's inability to secure qualified personnel for investigation and research work, the operations of the steamers *Albatross* and *Fish Hawk* were restricted during the fiscal year. The *Albatross* (excepting one trip in connection with the Chesapeake Bay survey, when the *Fish Hawk* was in quarantine) was not actively engaged and advantage was taken of the opportunity to make needed improvements to the crew's quarters, to modernize sanitary arrangements, to repair and strengthen deck houses, to replace sounding and dredging gear with approved appliances, and to renew the equipment generally. The ship has been lying at the Coast Guard depot at South Baltimore, and the advisability of placing her out of commission and releasing her naval officers and crew is under consideration.

The physical and biological survey of Chesapeake Bay, undertaken in the previous year, was continued by means of the steamer *Fish Hawk*, and has been practically completed in so far as need for that vessel is concerned. Seven trips, extending the entire length of the bay, were made, with a total mileage of 2,275. The plan of the work embraced observations at about 35 stations, and while each one was not occupied on every trip, 190 stations were made in all and 29 stations were made by the *Albatross*.

During the fiscal year three cruises were undertaken by the steamer *Halcyon*—two for the purpose of oceanographic investigations in the Gulf of Maine and one at the request of Massachusetts fishing interests in an endeavor to locate schools of mackerel. The latter cruise occurred in August and covered some 1,000 miles of fishing grounds in the Gulf of Maine and to the southwest and west of South Shoal Lightship. The results were almost entirely negative. The vessel was accompanied by practical mackerel fishermen who represented the Gloucester Board of Trade. The oceanographic cruises were made in December, January, and March, and were under the charge of Dr. Henry B. Bigelow. None of the trips was of long duration, but 23 stations were occupied with the use of appropriate apparatus and 1,286 miles were steamed between Cape Cod and Nova Scotia. During July and August the vessel was overhauled and contemplated improvements were completed. She is now equipped with a single drum hoist for dredging purposes and a complete electric-light system.

The auxiliary schooner *Eider* performed excellent service during the year as a tender for the Pribilof Islands, 10 round trips having been made between Unalaska and the islands for the transportation of cargo and passengers and one trip to King Cove. In November, 1920, it was necessary for the vessel to go to Kodiak for repairs which could not be made at Unalaska. The vessel was at sea every month in the year and cruised about 7,800 miles.

The small fishery patrol boats *Murre* and *Auklet* were engaged the greater part of the year in their usual work in southeastern Alaska for the protection of the fisheries. Transportation was afforded to a number of employees of other Government bureaus. In May the two vessels maintained a patrol in the vicinity of Sitka for the protection of the migrating fur-seal herd. The *Auklet* made a trip to Prince Rupert during May for the purpose of procuring foodstuffs needed by merchants of Wrangell and Ketchikan to relieve the shortage resulting from the steamship strikes. In June the *Auklet* towed the *Osprey* from Wrangell to Seattle and on the return trip towed the *Petrel* from Seattle to Wrangell. Each of the two boats cruised about 4,400 miles.

The *Phalarope*, *Gannet*, and *Shearwater* were occupied as usual in fish-cultural work, the first two on the New England coast, the last on Lake Erie.

The motor boats obtained by transfer from the Navy have been renamed, and two, the *Petrel* (formerly the *Cobra*) and the *Merganser* (formerly the *Calypso*), have been transported to Puget Sound on a naval collier and prepared for fishery patrol work in Alaska. A third, the *Curlew* (formerly the *Polly*), has been taken to Cape Vincent, N. Y., and is doing good service in connection with the fish-cultural operations on Lake Ontario. The *Fulmar* (formerly the *Wachusett*) is being fitted out for similar duty on Lake Michigan.

APPROPRIATIONS.

The regular appropriations for the support of the Bureau of Fisheries for the fiscal year 1921 aggregated \$1,216,310. The specific purposes for which the appropriations were made and the amounts thereunder were as follows:

| | |
|--|-----------|
| Salaries----- | \$448,810 |
| Pay of officers and crews of vessels for Alaska service----- | 26,000 |
| Miscellaneous expenses: | |
| Administration----- | 11,000 |
| Propagation of food fishes----- | 400,000 |
| Maintenance of vessels----- | 120,000 |
| Inquiry respecting food fishes----- | 45,000 |
| Fishery industries----- | 7,500 |
| Protecting sponge fisheries----- | 3,000 |
| Protecting seal and salmon fisheries----- | 140,000 |
| Special appropriations: | |
| Fur-seal islands, repairs and improvements----- | 10,000 |
| Fairport (Iowa) biological station, equipment----- | 5,000 |

Deficiency appropriations as follows, amounting to \$13,775, became available during the year:

| | |
|---|---------|
| Maintenance of vessels----- | \$4,422 |
| Protecting seal and salmon fisheries----- | 9,353 |

In accordance with law, a detailed statement of the expenditures under the regular and deficiency appropriations will be duly submitted.

Respectfully submitted.

HUGH M. SMITH,
Commissioner of Fisheries.

To Hon. HERBERT HOOVER,
Secretary of Commerce.





FIG. 1.—SALMON ON THE SPAWNING BEDS.

PACIFIC SALMON FISHERIES.^a

By JOHN N. COBB.

CONTENTS.

| | Page. |
|---|-------|
| Introduction..... | 6 |
| The species of salmon and the runs..... | 6 |
| Chinook, quinnat, or king salmon..... | 7 |
| Sockeye, blueback, or red salmon..... | 8 |
| Silver or coho salmon..... | 10 |
| Humpback or pink salmon..... | 10 |
| Dog or chum salmon..... | 11 |
| Steelhead trout..... | 11 |
| Age of salmon at maturity..... | 12 |
| Marking salmon..... | 13 |
| Ocean home of the salmon..... | 16 |
| Fishing grounds and history of the fisheries..... | 18 |
| Washington..... | 18 |
| Columbia River..... | 25 |
| Oregon..... | 31 |
| California..... | 34 |
| Alaska..... | 37 |
| Southeast Alaska..... | 37 |
| Prince William Sound and Copper River..... | 49 |
| Cook Inlet..... | 50 |
| Afognak Island..... | 51 |
| Kodiak Island..... | 52 |
| Chignik Bay..... | 55 |
| Alaska Peninsula, south side..... | 57 |
| Shumagin and Sannak Islands..... | 57 |
| Bering Sea..... | 58 |
| Nushagak River and Bay..... | 58 |
| Kvichak River and Bay..... | 61 |
| Naknek River..... | 62 |
| Ugagak River..... | 63 |
| Ugashik River..... | 63 |
| Alaska Peninsula, Bering Sea side..... | 65 |
| Kuskokwim River..... | 66 |
| Yukon River..... | 66 |
| Miscellaneous places..... | 67 |
| Arctic Ocean..... | 67 |
| British Columbia..... | 67 |
| Salmon fishing in the headwaters..... | 74 |
| Apparatus and methods of the fisheries..... | 75 |
| Gill nets..... | 75 |
| Haul seines..... | 76 |
| Diver nets..... | 77 |

^aAppendix I to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. No. 932.

| Apparatus and methods of the fisheries—Continued. | | Page. |
|---|--|-------|
| Dip nets..... | | 77 |
| Squaw nets..... | | 77 |
| Purse seines..... | | 78 |
| Traps or pound nets..... | | 79 |
| Indian traps..... | | 82 |
| Wheels..... | | 83 |
| Reef nets..... | | 84 |
| Trolling..... | | 86 |
| Bow and arrow..... | | 89 |
| Spear and gaff..... | | 90 |
| Sport fishing for salmon..... | | 90 |
| Dangers to the industry..... | | 91 |
| Fishing season in Alaska..... | | 95 |
| Fishermen and other employees..... | | 96 |
| Fishermen..... | | 96 |
| Cannery labor..... | | 97 |
| Nationalities..... | | 97 |
| Chinese contract system..... | | 98 |
| Fisheries of boundary waters..... | | 100 |
| Washington and Oregon..... | | 100 |
| Washington and British Columbia..... | | 103 |
| Decrease in sockeye salmon run..... | | 104 |
| American-Canadian Fisheries Conference..... | | 106 |
| Decrease in humpback salmon catch..... | | 110 |
| Packs by Canadian and American cannery..... | | 111 |
| Methods of preparing salmon..... | | 111 |
| Canning..... | | 111 |
| Early days of the industry..... | | 111 |
| Handling the salmon..... | | 114 |
| Dressing..... | | 115 |
| Cutting..... | | 115 |
| Salting..... | | 116 |
| Filling the cans..... | | 116 |
| Cooking..... | | 118 |
| Repairing cans..... | | 119 |
| Lacquering..... | | 119 |
| Labeling..... | | 121 |
| Brands..... | | 121 |
| Boxing or casing..... | | 123 |
| Can making..... | | 123 |
| Canning smoked salmon..... | | 124 |
| Home canning..... | | 124 |
| Inspection of plants packing canned salmon..... | | 125 |
| Investigation of canned salmon industry..... | | 126 |
| Mild curing..... | | 129 |
| Pickling..... | | 133 |
| Dry salting..... | | 134 |
| Smoking..... | | 134 |
| Freezing..... | | 136 |
| Utilizing salmon eggs and melt..... | | 139 |
| Miscellaneous products..... | | 140 |
| Meal, fertilizer, and oil..... | | 141 |
| Shipping fresh salmon direct to consumer..... | | 142 |

| | Page. |
|--|-------|
| Nutritive qualities of salmon..... | 143 |
| Analyses of canned and fresh Pacific salmon..... | 143 |
| Analyses of canned salmon by South Dakota authorities..... | 144 |
| Analysis of salted salmon..... | 146 |
| Statistics of the salmon output..... | 146 |
| Salmon catch in 1918..... | 146 |
| Bristol Bay waters salmon catch, 1913 to 1917..... | 149 |
| Pack of canned salmon in 1919..... | 150 |
| Canning industry, 1864 to 1919..... | 152 |
| Summary of canning industry..... | 152 |
| Canning industry, by species and waters..... | 153 |
| Market prices for canned salmon..... | 175 |
| American opening prices..... | 176 |
| British Columbia opening prices..... | 179 |
| Pickling industry..... | 180 |
| Mild-curing industry..... | 182 |
| Yukon Territory, Canada..... | 183 |
| Trade with outlying possessions..... | 183 |
| Hawaii..... | 184 |
| Porto Rico..... | 184 |
| Philippine Islands..... | 184 |
| Alaska..... | 185 |
| Guam..... | 185 |
| Tutuila, Samoa..... | 185 |
| Foreign trade in salmon..... | 185 |
| Exports of domestic canned salmon..... | 186 |
| Exports of domestic fresh and cured salmon..... | 195 |
| Imports of fresh salmon..... | 201 |
| Imports of cured salmon..... | 202 |
| Exports of Canadian canned salmon..... | 203 |
| Salmon culture..... | 203 |
| Obtaining the spawning fish..... | 203 |
| Taking the eggs..... | 204 |
| Fertilizing the eggs..... | 205 |
| Hatching apparatus and methods..... | 206 |
| Handling eggs in hatchery..... | 207 |
| Removal of dead eggs by the use of salt solution..... | 208 |
| Feeding and planting the fry..... | 211 |
| Packing eggs for shipment..... | 211 |
| Rearing salmon fry..... | 211 |
| Food..... | 212 |
| Salmon sold after stripping..... | 213 |
| Salmon hatcheries on the Pacific coast..... | 213 |
| General statistics..... | 214 |
| Acclimatizing Pacific salmon in other waters..... | 218 |
| California..... | 220 |
| History..... | 220 |
| Output..... | 222 |
| Distribution..... | 224 |
| Oregon..... | 228 |
| Hatcheries on coastal streams..... | 228 |
| Distribution..... | 229 |

| | |
|--------------------------------------|-------|
| Salmon culture—Continued. | Page. |
| Columbia River and tributaries..... | 233 |
| Washington..... | 237 |
| British Columbia..... | 244 |
| Alaska..... | 247 |
| The salmon fisheries of Siberia..... | 253 |
| Species of salmon..... | 254 |
| Fishing districts..... | 254 |
| Fishery rights and regulations..... | 255 |
| Apparatus employed..... | 257 |
| Abundance of salmon..... | 258 |
| Freezing salmon..... | 259 |
| Canning salmon..... | 260 |
| Salting salmon..... | 263 |
| The salmon fisheries of Japan..... | 265 |
| Canning industry..... | 266 |
| Fishery methods..... | 267 |
| Fish culture..... | 268 |

INTRODUCTION.

The most valuable commercial fisheries in the world, excepting only the oyster and herring fisheries, are those supported by the salmon. Of these the most important by far are the salmon fisheries of the Pacific coast of North America, where California, Oregon, Washington, and Alaska, including also British Columbia, possess industries representing millions of dollars of investment and millions of output annually. In Siberia the fishery is increasing in importance annually as means of transportation become better, while Japan is also becoming a large factor in the salmon markets of the world through her investments in the salmon fisheries of Siberia and, to a lesser extent, through fisheries prosecuted in her own waters.

In this third edition of the report^a considerable new material has been added, while some chapters have been entirely remodeled and materially enlarged. The statistical data have been brought up to January 1, 1920. The author is indebted to the Pacific Fisherman, of Seattle, Wash., for certain illustrations and to George C. Teal for permission to use his copyrighted picture shown as figure 11. Most of the illustrations are from pictures taken by the author.

THE SPECIES OF SALMON AND THE RUNS.

The Pacific coast salmons are all included in the genus *Oncorhynchus*. With them the fishermen incorrectly class the steelhead trout, which really belongs to the closely related genus *Salmo*.

As long ago as 1731 the species of *Oncorhynchus* were first made known by Steller, who, almost simultaneously with Krascheninikov, another early investigator, distinguished them with perfect accuracy under their Russian vernacular names. In 1792 Walbaum adopted these vernacular names in a scientific nomenclature for these fishes.

^a First edition: The Salmon Fisheries of the Pacific Coast. By John N. Cobb. U. S. Bureau of Fisheries Document No. 751, 180 pp., Washington, 1911.

Second edition: Pacific Salmon Fisheries. By John N. Cobb. U. S. Bureau of Fisheries Document No. 839, Appendix 111, Report, U. S. Commissioner of Fisheries, 1916, 255 pp., 29 pls. Washington, 1917.

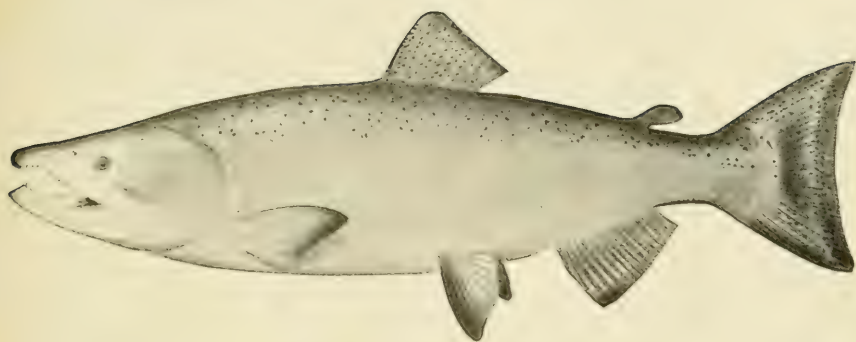


FIG. 2.—CHINOOK SALMON. BREEDING MALE.



FIG. 3.—SOCKEYE SALMON. ADULT MALE.



FIG. 4.—COHO SALMON. BREEDING MALE.



FIG. 5.—CHUM SALMON. BREEDING MALE.



FIG. 6.—HUMPBACK SALMON. ADULT MALE.



FIG. 7.—STEELHEAD TROUT.

Five species of salmon (*Oncorhynchus*) are found in the waters of the north Pacific, ranging northward from Monterey Bay on the American coast and Japan on the Asiatic, the extreme northern distribution of certain of the species having not yet been accurately determined. The five species are: (1) *Oncorhynchus tshawytscha*, quinnat, tyee, chinook, spring, or king salmon; (2) *Oncorhynchus nerka*, blueback, red, sukkegh, or sockeye salmon; (3) *Oncorhynchus kisutch*, silver, coho, or white salmon; (4) *Oncorhynchus keta*, dog, keta, or chum salmon; and (5) *Oncorhynchus gorbusha*, humpback or pink salmon.

CHINOOK, QUINNAT, OR KING SALMON.

The largest, best known, and most valuable of these is the chinook or king salmon (*O. tshawytscha*). It is found throughout the region from the Ventura River, Calif., to Norton Sound, Alaska, and on the Asiatic coast as far south as northern China. As knowledge extends, it will probably be recorded in the Arctic.

In the spring the body is silvery, the back, dorsal fin, and caudal fin having more or less of round black spots, and the sides of the head having a peculiar tin-colored metallic luster. In the fall the color is, in some places, black or dirty red. The fish has an average weight of about 22 pounds, but individuals weighing 70 to over 100 pounds are occasionally taken. One was caught near Klawak, Alaska, in 1909, which weighed 101 pounds without the head. The Yukon River is supposed to produce the finest examples, although this supposition is not based on very reliable observations. The southeast Alaska fish average as high as 23 pounds in certain seasons, followed by an average of about 22 pounds in the Columbia River and about 16 pounds in the Sacramento.

In most places the flesh is of a deep salmon red, but in certain places, notably southeast Alaska, Bristol Bay, Puget Sound, and British Columbia, many of the fish, the proportion being sometimes as much as one-third of the catch, have white flesh. A few examples have been taken with one side of the body red and the other white, while some are found with mottled flesh. No reasonable explanation of this phenomenon has yet been given.

In its southern range the quinnat strikes in at Monterey Bay in sufficient numbers to justify commercial fishing about the middle of April, where it is seen feeding upon the inshore moving schools of herring and sardines, continuing until in August. There are two runs of spawning fish in the Sacramento, the first or "spring run" beginning in April and continuing throughout May and June, these fish spawning mainly in the cold tributaries of the Sacramento, such as the McCloud and Fall Rivers. The second or "fall run" occurs in August, September, and October, and these fish spawn in the riffles in the main river between Tehama and Redding, also entering the tributaries in that vicinity. The two runs merge into each other. It is also claimed that there is a third run which comes in December.

In former years the San Joaquin and the American and Feather Rivers of the Sacramento system had large runs of salmon, but excessive fishing and the operation of various mining and irrigation projects have practically depleted them.

The Eel and Mad Rivers of northern California have only a late or fall run, while the Klamath River has both a spring and a fall

run, and Smith River has a spring run alone. Rogue River in Oregon has both a spring and a fall run, and the Umpqua and several other coast streams of Oregon have small early runs.

The Columbia River has three runs, the first entering during January, February, and March, and spawning mainly in the Clackamas and neighboring streams. The second, which is the best run, enters during May, June, and part of July, spawning mainly in the headwaters. The third run occurs during late July, August, September, and part of October, and spawns in the tributaries of the lower Columbia.

In Puget Sound chinook salmon are found throughout the year, although it is only during the spawning season that they are very abundant. In the Fraser River, a tributary of the Sound, the run occurs from March to August.

In the Skeena River, British Columbia, the run occurs from May to July, the same being approximately true of the Nass also.

In southeast Alaska they are found all months of the year. From March to the middle of June they are abundant and feeding in the numerous straits and sounds; in May and June the spawning fish enter the Unuk, Stikine, Taku, Chilkat, Alsek, and Copper Rivers in large numbers, and in a few smaller streams in lesser abundance. In August, September, and October they are again to be found in large numbers feeding in the bays and sounds, while during the winter months a few have been taken on trawls set for halibut, showing that they are living in the lower depths at this time.

In Cook Inlet the run occurs during May and June and is composed wholly of red-meated fish; in the rivers of Bristol Bay the run comes in June and July, principally in the first-named month, and the same is true of the Togiak, Kuskokwim, and Yukon Rivers, the late appearance of the fish in the upper courses of the Yukon being due to the immense distance the fish have to cover.

SOCKEYE, BLUEBACK, OR RED SALMON.

The red or blueback salmon (*O. nerka*), which forms the greatest part of the canned salmon of the world, when it first comes in from the sea is a clear bright blue above in color, silvery below. Soon after entering the river for the purpose of spawning the color of the head changes to a rich olive, the back and sides to crimson, and finally to a dark blood red, and the belly to a dirty white. The maximum weight is about 12 pounds, and length 3 feet, with the average weight about 5 pounds, varying greatly, however, in different localities. Observations of Chamberlain^a in Alaska show that the average weight of a number of sockeyes taken from Yes Bay was 8.294 pounds, while the average weight of a number from Tamgas was only 3.934 pounds. Evermann and Goldsborough^b report as a result of the weighings of 1,390 red salmon, taken from as many different places in Alaska as possible, an average weight for the males of 7.43 pounds; for the females, 5.78 pounds; or an average weight for both sexes of 6.57 pounds. A run of small, or dwarf, males accompanies certain of the main runs, being especially noticeable in the Chignik Lagoon

^aSome Observations on Salmon and Trout in Alaska. By F. M. Chamberlain, naturalist, U. S. Fisheries steamer *Albatross*. U. S. Bureau of Fisheries Document No. 627, p. 80. Washington, 1907.

^bThe Fishes of Alaska. By B. W. Evermann and E. L. Goldsborough. Bulletin, U. S. Bureau of Fisheries, 1906, Vol. XXVI, p. 257. Washington, 1907.

(Alaska) run. This species usually enters streams with accessible lakes in their courses.

These fish are occasionally found landlocked in certain lakes, especially in the State of Washington, and are always much smaller in size than the sea-run fish. In Bumping Lake, near North Yakima, Wash., they are quite abundant and are mature when about a pound in weight. Despite the fact that these fish have a soft mouth, anglers consider them very gamey. They take bait, the fly, and the trolling spoon. Large numbers are hatched and distributed by the Washington Fish and Game Commission under the name of "silver trout."

A few specimens of the sockeye have been taken as far south as the Sacramento River. In Humboldt County, Calif., small runs are said to occur in Mad and Eel Rivers, while 20 sockeyes are reported as having been taken in the Klamath River in the autumn of 1915. Only an occasional specimen appears in the coastal streams of Oregon. The Columbia is the most southern river in which this species is known to run in any considerable numbers, entering the river with the spring run of chinooks. From here south the species is called blueback exclusively. A considerable run enters the Quinault River, Wash., and there is also a small run in Ozette Lake, just south of Cape Flattery.

In the Puget Sound region, where it is known as the sockeye, this species ascends only the Skagit River in commercial numbers, although a small run appears in the Lake Washington system of lakes and, possibly, in the Snohomish, Stillaguamish, and Nooksack Rivers.

At one time the greatest of all the sockeye streams was the Fraser River, British Columbia, a stream famous from very early days for its enormous runs of this species, a peculiar feature of which is that there is a marked quadrennial periodicity in the run. The maximum run occurs the year following leap year, the minimum on the year following that. The greater part of the catch of the Puget Sound fishermen is made from this run as it is passing through Washington waters on its way to the Fraser. The fish strike in during July and August on the southwest coast of Vancouver Island, apparently coming from the open sea to the northwest. They pass through the Straits of Juan de Fuca, Rosario, and Georgia, spending considerable time in the passage and about the mouth of the river. Small numbers run as early as May and as late as October, but the main body enters about the first week in August.

The sockeye occurs in most of the coastal streams of British Columbia, and is usually the most abundant species. The principal streams frequented are the Skeena, Rivers Inlet, Nass, Lowe Inlet, Dean Channel, Namu Harbor, Bella Coola, Smith Inlet, Alert Bay, and Alberni Canal.

In Alaska, where this fish is generally known as the red salmon, it is abundant and runs in great numbers in all suitable streams, of which the following are the most important: In southeast Alaska, Boca de Quadra, Naha, Yes Bay, Thorne Bay, Karta Bay, Nowiskay, Peter Johnson, Hessa, Hetta, Hunter Bay, Klawak, Redfish Bay, Stikine, Taku, Chilkoot, Chilkat, Alesek, Situk, Ankow, etc.; in central Alaska, Copper, Knik, Kenai, Susitna, Afognak, Karluk, Alitak, Chignik; and in the Bristol Bay region, the Ugashik, Ugaguk, Naknek, Kvichak, Nushagak, and Wood. It is also supposed to

occur in small numbers in the Togiak, Kuskokwim, and Yukon Rivers, which debouch into Bering Sea, and possibly occurs in the Arctic streams of Alaska. The run in western Alaska begins usually early in June and extends usually to the middle of August, the bulk of the run occurring in the first three weeks of July. It begins earlier in Prince William Sound, however, and sometimes extends into September in southeast Alaska. The duration of the run averages about the same in each section.

SILVER OR COHO SALMON.

The silver or coho salmon (*O. kisutch*) is silvery in spring, greenish on the upper parts, where there are a few faint black spots. In the fall the males are mostly of a dirty red. The flesh in this species is of excellent flavor, but paler in color than the red salmon, and hence less valued for canning purposes. The maximum weight is about 30 pounds, with a general average of about 6 pounds.

The silver salmon is found as far south as Monterey Bay, where it appears during the month of July, and is taken by the trollers. From Eel River, in California, north, it is found in most of the coastal streams. It usually appears in July, and runs as late as November, the time of appearance and disappearance varying somewhat in different sections. Owing to its late appearance comparatively few, and they usually in the early part of the season, are packed by the canneries, most of which shut down in August and September. This fish also tarries but a short time about the mouth of the stream it is to enter, and is wary of nets, which makes it rather unprofitable to fish for the latter part of the season when it is running alone.

HUMPBACK OR PINK SALMON.

The humpback or pink salmon (*O. gorbuscha*), the smallest of American species, weighs from 3 to 11 pounds, the average being about 4 pounds. Its color is bluish above, silvery below, the posterior and upper parts with many round black spots, the caudal fin always having a few large black spots oblong in shape. The males in fall are dirty red and are very much distorted in shape, a decided hump appearing on the back, from which deformity the species acquires its name. The flesh is pale, hence its canned name, "pink" salmon.

The southern limit of the fish is the San Lorenzo River, Santa Cruz County, but only occasional specimens are found here and in the rivers to the northward until Puget Sound is reached. Here a large run appears every other year, the only place on the coast where such is the case.

The humpback occurs in varying abundance in the waters of British Columbia, but it is in the waters of southeast Alaska that it appears in its greatest abundance. Many of the canneries in this region and some of those operating in central Alaska depend mainly upon the humpback for their season's pack, and the canned product now occupies an excellent position in the markets of the world. The fish spawn in nearly all of the small, short streams.

In western Alaska the runs are much smaller and the humpback is not much sought after by the cannery men, who are usually able to fill their cans with the more valuable species.

In southeast Alaska the run begins in June and continues until September. In western Alaska the period is somewhat shorter. In Puget Sound it continues until late in the fall, although but few are taken after September 15.

DOG OR CHUM SALMON.

The dog or chum salmon (*O. keta*) reaches a maximum weight of 16 pounds, the average being about 8 pounds. When it first appears along the coast it is dirty silvery, immaculate or sprinkled with small black specks, the fins dusky, the sides with faint traces of gridironlike bars. Later in the season the male is brick red or blackish, and its jaws are greatly distorted. Its flesh is light yellow, especially when canned. It is especially good for freezing, salting, and smoking.

This species has a wide distribution. It is found as far south as San Lorenzo River, Santa Cruz County, Calif., but is not utilized commercially in California except on Eel River. It is found in most of the coastal streams from here north, being especially abundant from Puget Sound northward to southeast Alaska, both inclusive. In this region it is being utilized in greater abundance each year, as the market for it widens.

In central, western, and arctic Alaska the species occurs in varying abundance, but it is utilized sparingly, except by the natives, with whom it is the favorite species dried for winter food for their dogs.

The run of dog salmon comes later than that of any other species except the coho. In Alaska it begins in June, but the height of the season does not occur until late in August or early in September, and fish are found as late as November. In Puget Sound they run from about the middle of August till late in November, and practically the same is true in the Columbia River.

STEELHEAD TROUT.

The steelhead trout (*Salmo gairdneri*) is commonly classed as one of the salmon by the fishermen of the Pacific coast, and it has been included in this report on this account. It is said to have received its common name from the hardness of the skull, several blows of the club being required to kill the salmon when taken into the boat. In different localities the average weight is placed at from 8 to 15 pounds, while extreme sizes reach 45 pounds. The excellent quality of its flesh causes it to be highly prized for the fresh and frozen markets, but owing to its pale color only limited quantities are canned.

The principal center of abundance of this species is the Columbia River. It is found from Carmel River, Calif., north to central Alaska, and possibly has an even wider range in Alaska. As a result of extensive plants made during the last five or six years the range has been much extended on the Pacific coast as well as elsewhere in this country. It seems to be found in the rivers during the greater part of the year. In the Columbia River the spawning season is from February to May, in Puget Sound in the spring, and in southeast Alaska in May and June. The best commercial fishing is in January, February, and March. In California the catching of this species is restricted to hook and line fishing.

AGE OF SALMON AT MATURITY.

As practically all salmon which have the opportunity spawn but once and then die, knowledge of the age at which this occurs is of great interest both from an economic and scientific standpoint. Many attempts have been made to solve the problem with the sockeye and king salmon, the most important commercially of the five species, by means of marking artificially reared fry, usually by clipping one of their fins before they are liberated, as noted elsewhere in this report, but with unsatisfactory results.

Fortunately, certain experiments carried on in Tomales Bay, Calif., and in New Zealand, where king fry were planted in streams not frequented by the species in question and the return of the adults noted, have yielded some interesting and accurate information on the subject. These indicated that the age was four or more years, as no run was reported until the fourth year.

A more certain method of determining the age of salmon has been developed in recent years through the adaptation by American scientists of the discovery by European investigators that the ridges observed on the scales of certain fishes indicated a period of growth of the animal itself.

Dr. Charles H. Gilbert, of Stanford University, as early as 1910, applied this method to the determination of the age of the various species of Pacific salmon. As to its application to the Pacific salmon and the general method followed, Dr. Gilbert has the following to say:

While the method is new as regards Pacific salmon, it has been experimentally tested and fully approved by the Fisheries Board of Scotland in the case of the Atlantic salmon, and is now universally accepted as furnishing reliable data as to the age and many other facts in the life history of that fish. It has been shown to be applicable also to various species of trout, and its value has been demonstrated in fishes as widely divergent as the carp, the eel, the bass, the flounder, and the cod. Descriptions of this scale structure and its significance have appeared in a large number of papers, both scientific and popular. It will suffice here to repeat that the scale in general persists throughout life, and grows in proportion with the rest of the fish, principally by additions around its border. At intervals there is produced at the growing edge a delicate ridge upon the surface of the scale, the successive ridges thus formed being concentric and subcircular in contour, each representing the outline of the scale at a certain period in its development. Many of these ridges are formed in the course of a year's growth, the number varying so widely in different individuals and during successive years in the history of the same individual that number alone can not be depended on to determine age. For this purpose we rely upon the fact that the fish grows at widely different rates during different seasons of the year, spring-summer being a period of rapid growth and fall-winter a season when growth is greatly retarded or almost wholly arrested. During the period of rapid growth the ridges are widely separated, while during the slow growth of fall and winter the ridges are crowded closely together, forming a dense band. Thus it comes that the surface of the scale is mapped out in a definite succession of areas, a band of widely spaced rings always followed by a band of closely crowded rings, the two together constituting a single year's growth. That irregularities occur will not be denied, and this is natural, inasmuch as growth may be checked by other causes than the purely seasonal one. Also a considerable experience is requisite for the correct interpretation in many cases, and a small residue of doubtful significance has always remained. This element is too small to affect the general results, and further investigation will almost certainly eliminate the doubtful cases altogether.^a

^a Age at Maturity of the Pacific Coast Salmon of the Genus *Oncorhynchus*. By Charles H. Gilbert Bulletin, U. S. Bureau of Fisheries, 1912, Vol. XXXII, pp. 4, 5. Washington, 1913.

As a result of his investigations up to this point, Dr. Gilbert presented the following conclusions drawn from the data collected:

1. The sockeye spawns normally either in its fourth or fifth year, the king salmon in its fourth, fifth, sixth, or seventh year, the females of both species being preponderatingly 4-year fish.
2. The young of both sockeye and king salmon may migrate seaward shortly after hatching, or may reside in fresh water until their second spring. Those of the first type grow more rapidly than the second, but are subject to greater dangers and develop proportionately fewer adults.
3. Coho salmon spawn normally only in their third year. The young migrate either as fry or yearlings, but adults are developed almost exclusively from those which migrate as yearlings.
4. Dog salmon mature normally either in their third, fourth, or fifth years, the humpback always in their second year. The young of both species pass to sea as soon as they are free swimming.
5. The term "grilse," as used for Pacific salmon, signifies conspicuously undersized fish which sparingly accompany the spawning run. They are precociously developed in advance of the normal spawning period of the species. So far as known, the grilse of the king salmon, coho, and dog salmon are exclusively males; of the sockeye, almost exclusively males, except in the Columbia River, where both sexes are about equally represented. The larger grilse meet or overlap in size the smaller of those individuals which mature one year later at the normal period.
6. Grilse of the sockeye are in their third year, of the king salmon in their second or third year, of the coho and the dog salmon in their second year.
7. The great differences in size among individuals of a species observed in the spawning run are closely correlated with age, the younger fish averaging constantly smaller than those one year older, though the curves of the two may overlap.^a

Since 1910 Dr. Gilbert has devoted much of his time to investigations^b along this line, especially on the sockeye, with most interesting and valuable results.

His observations on the sockeye runs of British Columbia indicate that they consist principally of four and five year fish and that these two classes appear during successive seasons in widely differing proportions; that each stream has its distinctive race of sockeye, the progeny returning at maturity to the parent stream; that sockeye fry rarely survive when they proceed to sea within the year in which they are hatched; and that sea feeding, with the consequent rapid growth, is the most important factor in producing early maturity, an equal number of years in fresh water producing comparatively little effect.

MARKING SALMON.

A favorite recreation for quite a number of Pacific coast people has been the marking of salmon fry in order to find out the age at which they return to spawn, the rate of growth, etc. Scattered through the reports of the various State fish commissions, and occasionally in the reports of the United States Bureau of Fisheries, are to be found detailed reports of such markings and the sometimes remarkable

^a Age at Maturity of the Pacific Coast Salmon of the Genus *Oncorhynchus*. By Charles H. Gilbert. Bulletin, U. S. Bureau of Fisheries, 1912, Vol. XXXII, pp. 21, 22. Washington, 1913.

^b Contributions to the Life History of the Sockeye Salmon. (No. 1.) By C. H. Gilbert. Report of British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1913, with Appendices, pp. R53-78. Contributions to the Life History of the Sockeye Salmon. (No. 2.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1914, with Appendices, pp. N45-75. Contributions to the Life History of the Sockeye Salmon. (No. 3.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1915, with Appendices, pp. S27-64, 6 pls. Contributions to the Life History of the Sockeye Salmon. (No. 4.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1917, with Appendices, pp. Q33-80, 14 pls. Contributions to the Life History of the Sockeye Salmon. (No. 5.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1918, with Appendices, pp. X26-52, 24 pls. Contributions to the Life History of the Sockeye Salmon. (No. 6.) By C. H. Gilbert. Report, British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1919, with Appendices, pp. U35-68, 6 pls. Victoria, British Columbia.

results attained, apparently at varying periods subsequent to the marking.

All sorts of marks were employed. The favorite was the removal of the adipose fin, the experimenters appearing to be of the opinion that the fish would miss this the least of any. However, the entire or partial removal of nearly every fin was practiced by some one or other of the many experimenters. Sometimes a V or a U was punched out of the tail or the gill cover, and in one or two instances a tag was employed.

In time these marking experiments became so numerous, and so imperfect a record was kept of them by any central authority, that frequently it was impossible to tell, when an apparently marked specimen was obtained, where and when it was marked, and as a result but little dependence could have been placed upon them even had there been no other factors conspiring to vitiate their value.

Fishermen are continually finding in their nets salmon which they feel sure have been marked by some hatchery. Scores of times in the course of his various investigations of the fisheries of this coast the writer has been told of or shown specimens which the fishermen thought had been marked. Many of these marks were on the side of the fish and represented an M or W, depending upon the angle from which viewed, and it was impossible, generally, to convince the fishermen that this mark was caused by the twine of his gill net pressing on the side of the fish. The obvious fact that a fish could not survive when in the fry stage the infliction of such a mark did not occur to them.

Frequently the scars left by the suctorial organs of the lamprey have been mistakenly supposed to be hatchery marks. This scar resembles very closely a date stamp on a canceled letter.

One of the most interesting cases of salmon marking, and one which drives home the necessity for accepting reports of returns from such markings with extreme caution, is that of F. M. Chamberlain, then naturalist of the Bureau of Fisheries steamer *Albatross*, on the Naha Stream in Alaska.

In August, 1903, 1,600 red salmon fry, reared for the purpose from the 1902 eggs, at the Fortmann hatchery of the Alaska Packers Association, near Loring, Alaska, were marked by Mr. Chamberlain by excising both ventrals with fine curved scissors. The fry were released in the Naha River as soon as marked, at which time they were about three months old.

In 1906 between 50 and 100 adult reds with ventral fins missing were reported by the superintendent of the hatchery at Yes Bay, which is located on the northern side of Behm Canal (Naha being on the southern side) and some 15 miles farther up the canal than the mouth of Naha Stream. Some of these also had the adipose removed, this mark having also been used on some of the fry. At the Fortmann hatchery, where they were marked, only two of these fish were obtained in 1906.

From then on until 1912, a period of $9\frac{1}{2}$ years, the return of a number of these supposedly marked fish is noted each year at the two hatcheries in question, the number reported in the latter year being larger than in some of the intervening years. In 1912 Mr. Chamberlain himself pointed out the impossibility of these all being from the fry he had marked and no further attention was paid to them.

The principal thing that this and some of the other many experiments in salmon marking prove is that the percentage of salmon which accidentally lose, either through disease or the attacks of their many enemies, one or more of their fins, or portions of same, is much larger than most people suppose. Out of the many millions taken annually in commercial and fish cultural operations it is not surprising that some should be minus such exposed portions of their anatomy and this percentage would doubtless be found to be considerable were particular attention directed toward it. As it is now, it is only occasionally that the fisherman notices such loss, or mentions the same when he does, unless his attention has been directed to it by particular inquiry. In the Chamberlain experiment, for instance, after 1907 considerable publicity was given to the search for such marked fish, and the writer, in his travels through southeast Alaska during the succeeding years until the end of 1911, frequently was told by fishermen that they had caught salmon with missing fins. Inquiry developed that while a few of the lost fins were the same as Chamberlain had excised, a number were entirely different fins, showing that when the attention of fishermen was directed especially in this line many deformed fish would be found.

The confusion resulting from the many marking experiments carried on by different people shows the absolute necessity of some central authority regulating them if any real results are to be achieved from this line of endeavor. In 1908 the Secretary of Commerce, under authority of sections 11 and 12 of the Alaska fisheries law, directed that any persons desiring to mark and release salmon in Alaska first consult with and secure the written consent of the Commissioner of Fisheries or of the agent at the salmon fisheries of Alaska. It would be an excellent thing if some such control could also be exercised over these operations in the coastal States.

During the year 1916 Dr. Charles H. Gilbert, of Stanford University, assisted by Willis H. Rich, conducted salmon-marking experiments on an extensive scale. Late in the fall of 1915 a consignment of 100,000 eggs of the red salmon was forwarded to Seattle, Wash., from the station of the Bureau of Fisheries at Yes Bay, Alaska, of which 50,000 were reshipped to the Anderson Lake hatchery of the British Columbia Fisheries Department, located on the ocean side of Vancouver Island. The remaining 50,000 were sent to the Bureau of Fisheries hatchery at Quinault Lake, near the coast of Washington. The intention was as soon as the fry, hatched from these eggs, had developed into fingerlings to mark each lot with a distinctive marking and plant them in waters near the hatcheries, with the object of proving that the adult fish would return to the stream in which they had passed their early existence, no matter where the eggs were taken.

This plan could not be carried out at Anderson Lake, as the young fish resulting from the eggs, which were sent there, were not strong enough to survive the experiment. They were therefore liberated without marking. Those hatched at Quinault Lake were marked, however, and liberated in the summer of 1916. Dr. Gilbert has strong hopes that upon the return of the marked fish important data relating to the life history of the species will be obtained.

During February, March, and April, 1916, some 50,000 yearling sockeyes, which had been reared at the Bonneville hatchery of the Oregon Fish and Game Commission from eggs obtained from the Yes

Bay (Alaska) hatchery of the United States Bureau of Fisheries, were marked by the removal of the adipose and both ventral fins, and the fish then liberated in Tanner Creek, a tributary of the Columbia. The fish were in an apparently healthy condition when liberated. In order to make sure that they suffered no ill effects from the marking a few were held until the wounds had healed perfectly, and these were not affected adversely.

During the summer of 1918 a number of marked fish were reported to have returned and been caught.

During the same period close watch was kept on the Quinault River for the return of marked sockeyes from that marking experiment but none were observed so far as known.

OCEAN HOME OF THE SALMON.

All sorts of conjectures have been hazarded as to the ocean home of the salmon after the young fish have gone to sea and disappeared apparently from the ken of man. Many have conjured up visions of the vast schools of adult salmon surging along the coast hundreds of miles seeking for some suitable river in which to spawn, explaining in this wise the variations in the seasonal runs in different sections. Others think the fish go out into the greater depths of the ocean and there hide from man until the spawning instinct leads them back to the coast and thence to the stream in which they were born or planted.

Discoveries of recent years have quite altered this uncertainty, and we now are reasonably certain that the vast majority of the salmon are comparatively near our coast line, while others stay in the bays, straits, and sounds virtually all the time when not in the rivers.

Some years ago it was first noticed that king salmon would take the hook while in salt and brackish waters. At first only the anglers were interested in this fact, but as the demand for king salmon for mild curing became more insistent the commercial fishermen, attracted by the high prices paid, began to devote some attention to the fish during the early spring months, and soon trolling became a recognized branch of the industry. It was first taken up on a considerable scale in southeast Alaska in 1905.^a As the demand for the fish increased, the fishermen extended operations until almost all of southeast Alaska waters were being fished. The length of the fishing season was also increased until now only the severe weather of winter prevents them from fishing. However, the halibut trawls occasionally come up during the season with king salmon on them, showing that they are still on the ground.

The above is also true to a certain extent of the waters of British Columbia and Puget Sound and to a lesser extent, so far as has been disclosed, of Monterey Bay and the Oregon coast.

It has been known for some years that the silver, or coho, salmon would also take the hook under practically the same conditions as the king salmon, and the only reason this species has not been fished for to the same extent as the king has been because it was not large enough to be attractive to the mild curers, and hence there was a much lesser demand for it.

^aReport on the Fisheries of Alaska. By John N. Cobb. Bureau of Fisheries Document No. 618, pp. 19-21. Washington, 1907.

It had been supposed that the other species did not feed when in coastal waters, but Marsh and Cobb ^a state quite differently:

Other species of salmon, in addition to the king, are found to take the trolling hook. For several weeks in July trollers in Union Bay, in southeast Alaska, caught a number of cohos and humpbacks while trolling for kings. The humpbacks were caught mainly with a spoon, no bait being used. Most of them appeared to have been feeding on needlefish and herring, according to the cutter who dressed them. A few red salmon are reported to have been caught on the trolling line by fishermen operating for king salmon in the neighborhood of Mary Island, near Dixon Entrance. Several fishermen report having in previous years frequently taken dog salmon on a hook in the bays along Chatham Strait.

In 1909, Mr. J. R. Heckman, of Ketchikan, Alaska, a well-known cannery man, told the writer that, while he was trying to install a floating trap near Cape Chacon, at the lower end of Prince of Wales Island, southeast Alaska, he on several occasions observed red salmon feeding on what he called a red shrimp.

This was also observed in 1912, when Dr. Gilbert reported, in connection with his observations of salmon fishing on Swiftsure Bank, off the Straits of San Juan de Fuca, that "during the past summer it was observed by Mr. J. P. Babcock and the writer that the sockeye on the Bank were feeding extensively on a small shrimp-like crustacean (*Thysanoessa spinifera*, Holmes), which floats in incredible numbers on the tides and forms a favorite food for the other species as well as for the sockeye." ^b He also found all the other species feeding voraciously in this neighborhood.

The experience of the fishermen operating in and off Port Moller, in Bering Sea, also affords confirmatory evidence along this line. A cannery was established on Port Moller in 1913, the avowed purpose of the owners being to catch what they claimed would be the enormous schools which annually resort to the great rivers of Bristol Bay, some 210 miles to the eastward from Port Moller. This cannery made a fairly large pack for a season or two, using purse seines in Bering Sea and traps along the shore. Misled by this, three other canneries were built in 1916 and 1917. In a season or two the catches of the combined plants had dropped to much less than the catch of the one cannery when operating alone, thus showing that the fishermen were operating on a run which was local to that neighborhood. This is borne out by the fact that the Bristol Bay runs showed no appreciable diminution when the catch was lowest at Port Moller. The pack of the Port Moller canneries follows.

PACK OF THE PORT MOLLER CANNERIES.

| Year. | Number of canneries. | Cases packed. | Year. | Number of canneries. | Cases packed. |
|-----------|----------------------|---------------|-----------|----------------------|---------------|
| 1913..... | 1 | 44,150 | 1917..... | 4 | 39,688 |
| 1914..... | 1 | 87,175 | 1918..... | 4 | 124,884 |
| 1915..... | 1 | 105,674 | 1919..... | 2 | 29,849 |
| 1916..... | 2 | 132,367 | | | |

^a The Fisheries of Alaska in 1909. By Millar C. Marsh and John N. Cobb. U. S. Bureau of Fisheries Document No. 730, p. 26. Washington, 1910.

^b The Salmon on Swiftsure Bank. By Charles H. Gilbert. Report of British Columbia Commissioner of Fisheries for Year ending Dec. 31, 1912, and Appendix, p. 116. Victoria, British Columbia.

These observations would tend to confirm the belief which has been steadily growing in favor for some years that the salmon either spend the greater part of their life in the bays, straits, and sounds, or else in regions adjacent to the coast line.

The reason they had not been found in this region earlier is doubtless due to the fact that during the fall, winter, and spring months the weather on the north Pacific coast is such that fishing operations can not be carried on along the open coast, while, in summer the fishermen are all busy on the spawning runs and have no time to devote to fish not yet arrived at maturity, which are probably feeding along the coast as usual.

FISHING GROUNDS AND HISTORY OF THE FISHERIES.^a

WASHINGTON.

Puget Sound.—Strictly speaking, the name Puget Sound should be restricted to that long, narrow arm extending south from the Strait of Juan de Fuca, but a practice has developed, and is now common among fishermen and others, of designating all the great water area in the State of Washington comprising Puget Sound proper, Strait of Juan de Fuca, Canal de Haro, Rosario Strait, the Gulf of Georgia, and the smaller straits, bays, and sounds, as Puget Sound, and this practice, for the sake of convenience, has been followed in this report.

This great indentation in the coast, with its numerous islands and many fine harbors, has greatly aided the development of this portion of Washington and has been specially favorable to the prosecution of the salmon and other fisheries. Numerous rivers and creeks enter the Sound, the more important of these being on the eastern shore and comprising the Nooksack, Skagit, Stillaguamish, Snohomish, Duwamish, Puyallup, and Nisqually. On the southern and western shores the tributary streams are nearly all small, the more important being the Skokomish, Quilcene, Dungeness, and Elwha.

As on other bodies of water on the Pacific coast frequented by salmon, the Indians were fishing for them when the first whites visited the country. The natives at this time, and for many years after, used reef nets and hooks and lines in the salt water, and spears, dip nets, and weirs in the rivers. Traders first reached the headwaters of the Fraser River and gradually worked down the same until they reached the sea.

For many years this region was comparatively isolated from the rest of the world, and the completion of transcontinental railroads has not completely changed this, owing to its distance from large consuming centers. As a result of this isolation, it was necessary for many years to resort to methods of preparation which would insure the preservation of the product for indefinite periods. Salting naturally came first, followed by canning, while the shipping of fresh salmon has been steadily growing in importance as transportation facilities increased.

The Northwest Co., a large fur-trading organization, about the beginning of last century first introduced the salting process and

^a For some of the regions the historical data are fragmentary and can not be considered as other than historical notes. It is hoped that some one will write a history of the industry before all of the pioneers have passed away.

this was continued by the Hudson Bay Co. Both companies carried on the business primarily for the purpose of providing a winter stock for the use of their employees and for local sale. As shipping developed on the Pacific, a considerable export trade in salted salmon was developed with the Hawaiian Islands, Australia, China, and Japan, and with the eastern United States.¹ Quinнат, or spring, and sockeye salmon were the principal species employed in the earlier years.

After the boundary line between Canada and the United States had been established in 1846, and what is now the State of Washington was acknowledged as part of the latter, a number of small traders and fish packers succeeded the Hudson Bay Co. In the early sixties several men were engaged in the business at Point Roberts, according to the *Olympia Columbian* of September 10, 1853. In 1873, V. T. Tull, of Olympia, established a salmon fishery at Mukilteo, principally for putting up fish in barrels. The first year 500 barrels were packed at Mukilteo, after which the fishery was moved temporarily to Seattle to take the late run up the Duwamish River, which is usually large. Fifteen hundred good large salmon have been taken at one haul of the seine in the Puyallup.

Bancroft's "*History of Washington, Idaho, and Montana*" contains among others the following references² to the early fishermen of the Sound:

In 1874 Corbette & Macleay, of Portland, founded a fishery at Tacoma. Sixty barrels were packed in five days, only three men being employed.—*New Tacoma Tribune*, November 14, 1874. In 1876, John Bryggot, a Norwegian, founded another fishery at Salmon Bay, 6 miles north of Olympia. In 1878 a company of Puget Sound men established a fourth at Clallam Bay. They put up the first season 600 casks of salmon and 700 of halibut.—*Morse's Wash. Terr., MS.*, xviii, 17-18. In the following season D. D. Hume established a fishery near Steilacoom for the purpose of salting salmon. In 1880 H. Levy, of Seattle, went to London with 100 barrels to introduce Puget Sound salted salmon to that market. In 1882 a salmon packing establishment was opened at Old Tacoma by ——— Williams. Salmon ran in great numbers this year. One boat brought in a thousand fish.

The extension of the railroad to Puget Sound, thus furnishing an outlet to the rapidly growing population in the Middle West, did much to aid the industry. This also gave opportunity to begin the shipping of fresh halibut and salmon to eastern points. Ainsworth & Dunn, of Seattle, operating later under the name of the Seattle Fish Co., were the first successful pioneers in this branch of the industry, beginning about 1889, and carrying it on until they sold out in 1901, as noted later.

In 1903 the San Juan Fishing & Packing Co., which had begun the fresh-fish business in 1899, bought this business from the Pacific Packing & Navigation Co., to which it had been sold in 1901.

In 1893 A. E. Wadhams, who had operated on the Columbia River for some years, established a sockeye plant at Point Roberts.

In 1894 both canneries were sold to their present owner, the Alaska Packers Association, an organization formed not long before this by a combination of a number of Alaska plants.

About 1894 A. E. Devlin came up from the Columbia River and established a plant at Friday Harbor, which is now operated by the Friday Harbor Packing Co.

¹ *History of the Pacific States, Washington, Idaho, and Montana, 1845-1889*, vol. 26, pp. 345-349. By Hubert Howe Bancroft.

In 1895 three new canneries were built at Anacortes—one by Philip S. Cook (later owned by the Porter Fish Co. and now by the Anacortes Fisheries Co.), one by the Anacortes Packing Co. (now owned by the Alaska Packers Association), and the other by the Fidalgo Island Canning Co. In the same year a cannery was built at Port Angeles by the National Packing Co. In 1902 this plant was sold to the Manhattan Packing Co., which company was absorbed by the Gorman interests in 1906.

In 1896 J. R. Young and B. L. Williams built a small cannery at Blaine. They failed in 1900 through the failure of their trap fisheries and J. W. & V. Cook Packing Co., of Portland, bought their plant and put J. L. Smiley in charge of it. In 1909 Mr. Smiley purchased this plant from the company and operated it until 1916, when he disposed of it to Lee Wakefield and E. Schoenwald, who sold it the following year to the Wilson Fisheries Co.

As Ainsworth & Dunn found that they were receiving more salmon than they could dispose of in a fresh condition (they were first, in 1889, to ship fresh salmon from here to eastern points), the firm built a cannery on the Seattle water front, at what is now Pier 8, about 1895 or 1896, and about 1897 built another at Blaine.

In 1900 the Blaine Packing Co. built a cannery at Blaine and operated it nearly every season until 1916, when it was sold to the Blaine Cannery Co.

In 1901 Ainsworth & Dunn sold all its fresh fish and canned salmon holdings to the newly organized Pacific Packing & Navigation Co. When the latter company failed and its assets were sold in 1904, the firm bought back its former Blaine plant and has operated it ever since. Mr. Ainsworth, the senior member of the firm, died in 1914, but the business is still operated under the name of Ainsworth & Dunn.

The Pacific American Fisheries Co. was incorporated in 1899. The company purchased at the time of its organization the cannery and trap properties of the Island Packing Co., San Juan Island, and the cannery of the Franco-American North Pacific Packing Co., at Fairhaven. The last-named cannery had been built the previous year.

By 1900 a number of canneries had been erected on the shores of Puget Sound, most of which were then in active operation. In 1901 the Pacific Packing & Navigation Co. was organized under the laws of the State of New Jersey, for the purpose of acquiring a number of salmon canneries on the coast. It was supposed to be backed by unlimited eastern capital, and its authorized capitalization was as follows: Common stock, \$12,500,000; 7 per cent accumulative preferred stock, \$12,500,000; and 6 per cent debentures, \$7,000,000. It actually issued \$6,037,000 common stock, \$6,963,000 preferred stock, and \$3,000,000 debentures. Subsequently the management effected an exchange of preferred stock for debentures, increasing the former to about \$7,500,000 and decreasing the debentures to about \$1,650,000.

The new company purchased a number of canneries in Alaska, also the following Puget Sound plants: Pacific American Fisheries Co.'s canneries at Fairhaven (now Bellingham) and Friday Harbor, the Ainsworth & Dunn canneries at Blaine and Seattle, and the Fairhaven Packing Co. cannery at Fairhaven.

The company had a very short career, ending up in the bankruptcy courts in 1903, and when all its affairs were wound up the stockholders received nothing, while the bondholders got but an exceedingly paltry sum out of all the money put into it.

Most of the canneries secured on Puget Sound were repurchased by their former owners or by new people.

The Apex Fish Co. was incorporated in 1904 and built a cannery at Anacortes which has been operated continuously since.

B. A. Seaborg, a well-known Columbia River packer, early in the century established a cannery in South Bellingham and operated it under the name of the Washington Packing Co. In 1905 it was purchased by R. A. Welsh, then of Vancouver, British Columbia, and Loggie Bros., of Bellingham, and has been operated since under the name of the Bellingham Canning Co.

The Hillside Canning Co.'s plant was built and operated for the first time at Port Townsend in 1905 by Andrew Weber, H. Ellerbeck, William McKee, and E. C. Seeley.

In 1906 T. J. Gorman, since deceased, purchased the cannery of the Rosario Straits Packing Co. at Anacortes.

In 1906 E. A. Sims leased the cannery at Port Townsend which had been built some years earlier by Mr. Cook and operated under the name of the Port Townsend Packing Co.

A one-line cannery was erected in the spring of 1906 by the Wadham-Curtis Canning Co. at Blaine, but it burned down the same year.

In 1897 the Chlopeck Fish Co. (now the Booth Fisheries Co.), which had been operating in Portland for several years, started a fresh fish and freezing business at Seattle.

The first salmon cannery on Puget Sound was erected by Jackson, Myers & Co., in 1877, at Mukilteo, in Snohomish County. The members of this firm had all been engaged previously in salmon canning on the Columbia River. The first pack was of 5,000 cases, composed wholly of silver, or coho, salmon. Later at this plant were put up the first humpbacks ever canned. In order to divert the minds of purchasers from the fact that the meat of the humpback was much lighter in color than the grades then known to the consuming public, the company printed on its label the legend, "Warranted not to turn red in the can." Even with this shrewd sizing up of the weak side of the consuming public the demand for humpback, or pink, salmon developed very slowly, and it was some years before it became a factor in the markets.

Within a year or two after the opening of the above plant another was started at Mukilteo by a man named Bigelow.

In 1880 the Myers's cannery was destroyed by a heavy fall of snow. It was rebuilt in West Seattle and was operated till 1888, when it was destroyed by fire. George T. Myers, now sole owner, built a new cannery at Milton, which was burned two years later, and he then came back to Seattle and built a cannery about where Ainsworth & Dunn's dock now stands. He remained here only one season, after which he moved to where the Pacific Coal Co.'s bunkers are now. Late in 1901 he sold out his plant to the United Fish Co., which company moved the plant to the foot of Connecticut Avenue, where they continued operations for two or three years and then quit.

In 1889 a man named Morse established a cannery at Seattle and operated it for only one year.

The first Puget Sound sockeye cannery was built at Semiahmoo, near Blaine, by J. A. Martin and John Elwood about the year 1891. It was bought in 1892 for \$500 by D. Drysdale, who shortly afterward rebuilt and greatly enlarged the plant. In the same year Mr. Drysdale demonstrated the commercial success of fish traps. Traps had been in operation before this, however. In 1893 Ainsworth & Dunn had a trap at Five Mile Rock, just beyond the lighthouse at Magnolia Bluff (now a part of Seattle), and there had been a trap or two in Elliott Bay even prior to this. Traps had not been profitable in this section, however, owing to the cheapness and abundance of salmon, haul seines being cheaper and more profitable to operate. A man named H. B. Kirby, who came originally from Nova Scotia, and another named Goodfellow (now living at Point Roberts) put in the first trap for Mr. Drysdale.

From this time on the industry fluctuated considerably, 41 canneries, an increase of 10 over 1914, being operated in 1915, while 35 were operated in 1919.

During the early years of sockeye canning they were not sold to the trade as sockeyes, but as Alaska reds and Columbia River salmon, for which there had been an established market for some years.

H. Bell-Irving & Co., of Vancouver, British Columbia, were the pioneers in the labeling of the fish as sockeyes, this being in 1894-95. Like all virtually new products, sockeye salmon had a hard fight for several years to secure a foothold in the salmon markets, and it was not until the Spanish-American War in 1898 caused a heavy demand for canned foods that its position became finally established.

Soleduck River.—This is a small stream, about 30 miles in length, which flows through the southwestern part of Clallam County and empties directly into the ocean. The Quillayute Indian Reservation is located here and the natives formerly caught salmon and marketed them on Puget Sound, but a small cannery, started at Mora, on this river, in 1912, furnished a market for the catch up to the end of 1915, when it was abandoned.

Hoh River.—This is a comparatively small river, which is wholly within Jefferson County, and debouches into the ocean in the northwestern part of the county. It passes through the Hoh Indian Reservation in its lower reaches. A cannery was built here in 1917 by Fletcher Bros., and has been operated each season since. In the spring of 1919 it was moved to a more convenient location about a mile from the original site.

Queets River.—This river, which is about 35 miles long, rises in the northern part of Jefferson County and empties directly into the ocean in the northwestern part of Grays Harbor County, within the bounds of the Quinault Indian Reservation. A small salmon cannery was built at Queets, in Jefferson County, in 1905, and has been operated every season since.

Quinault River.—This river, which enters the ocean in the northwestern part of Grays Harbor County, has a length from the ocean to Quinault Lake of about 40 miles, wholly within the boundaries of the Quinault Indian Reservation.

This stream is especially noted for its long-continued annual run of Quinault salmon (*O. nerka*). These fish, which are noted for

their especially red-colored flesh, make their appearance early in December, when the Indians generally catch them for their own use, as they fear that, if the whites got hold of the fish, they might throw away the hearts. Should a heart be eaten at this time by a dog or chicken, the Indians believe the run would not come. In January, when the fish begin to be abundant, all danger of this seems to have passed, for the Indians then usually have a considerable number for sale, and these are generally shipped to distant markets in a fresh condition by the buyers. As soon as the canneries open at Moclips most of the fish are disposed of at that place. The run continues up to July 1. May and June are the best fishing months.

There is a fall run of chinooks in this river, which usually arrives in August and ends about October 15.

The silver salmon appear about October 1 and the run is generally over by November 15; the dog salmon appear about November 1 and the run is usually over by the middle of the same month, while the steelhead trout run between November 20 and May 1. None of the latter are canned.

Moclips, the terminus of the railroad, is about 10 miles from the river, and the fish are all taken by team to this place. Twenty fish, weighing approximately 100 pounds, are put in each box, and these are piled onto the wagons until a load has been accumulated. The team owners get 50 cents a box for hauling the loaded ones to Moclips and 5 cents a box for bringing the empty ones back.

In 1915 the records of the Indian agent show that the Indians fishing on the north side of the river caught 219,654 Quinault salmon, valued at \$49,820, while those on the south side caught 135,353 of these fish, valued at \$30,528.60, or a grand total of 355,007 fish, valued at \$80,348.60. This does not take into account the results of the fishing for the other species of salmon and steelhead trout, which quite materially swell the total.

Fishing is restricted to the Indians, who also make their own fishery laws, with the advice and approval of the Office of Indian Affairs, as the State laws have no force inside the bounds of the reservation. Under the regulations now in force, a clear channel of one-third the width must be left in the middle of the stream, which is from 250 to 300 yards in width. Each owner of a fishing location has to fish it in person; provided, however, that widows, orphans, minor children, old Indians, and those who are sick or have gainful occupations other than fishing, are allowed to lease their locations or hire some one to fish them, and then only with the approval of the officer in charge.

During the Quinault season stake nets are used, while the rest of the time, as a result of the freshets, drift gill nets are used in the eddies. The stake nets are arranged in a rather peculiar manner. A line of stakes is run out for about one-third the width at right angles to the shore, and to these are attached a net by short ropes. From each stake a section of net is run out and downstream, curving inward like a hook at the end, the latter part being held in place by three stakes.

The stake nets are 40 to 60 meshes deep, with 5½-inch stretch mesh, and are set 85 yards apart. A set of these as described above forms one fishing location.

The chinook gill nets are usually $8\frac{3}{4}$ to 9 inches stretch mesh and 24 meshes deep, while the gill nets for silvers, dogs, and steelheads are of 7-inch stretch mesh and 35 meshes deep.

For some years the salmon from the Quinault River were brought to Hoquiam and Aberdeen for canning. In 1911 W. W. Kurtz, of the former place, began the erection of a cannery at Moclips for the purpose of packing these fish, and the same season his example was followed by Frank Shafer. Mr. Kurtz still operates his plant, but the other is now owned by the Pacific Fisheries & Packing Co.

Grays Harbor.—This is the first important indentation on the coast of Washington south of Cape Flattery. It is about 40 miles long from east to west and about 20 miles wide in the widest part. The principal tributary is the Chehalis River, but there are a number of small streams which debouch into the harbor.

In 1883 B. A. Seaborg, who operated a cannery on the Columbia River, established a plant at what was later to be the thriving city of Aberdeen, although at that time it was practically a wilderness.

In 1902 the North American Fisheries Co. built a plant at Aberdeen. Shortly after it came into the possession of the Grays Harbor Packing Co., and on June 8, 1903, it was destroyed by fire. It was rebuilt and operated by this company until 1906, when it was sold to S. Elmore & Co., who still own it.

The Hoquiam Packing Co. built a cannery at Hoquiam in 1904 and have operated it ever since.

In 1910 two canneries were in operation at Aberdeen and Hoquiam, respectively; in 1915 there were three at the former place and one at the latter, while in 1919 there were six in operation.

Willapa Harbor.—The entrance to this harbor, which also includes Shoalwater Bay, is about 27 miles south of Grays Harbor. The harbor runs east and west and is about 25 miles long. Shoalwater Bay extends south from it a distance of about 30 miles, its southern portion ending about a mile from the Columbia River and its western side being separated from the ocean by a spit varying in width from three-fourths to 1 mile. The bay is shallow, excepting in the main channel. The principal salmon streams entering the harbor are the Nasel and North Rivers, in which most of the pound or trap nets are located.

In 1884 B. A. Seaborg, a Columbia River canner, established a plant on Shoalwater Bay, as the whole of Willapa Harbor was then known.

About 1900 F. C. Barnes established a cannery at Sunshine, on the Nasel River, but the run of salmon on this river soon became so small that the plant was abandoned and the machinery moved to Mr. Barnes's cannery at South Bend.

In 1904 P. J. McGowan, the Columbia River canner, opened a cannery on the North River. Mr. McGowan, who was over 80 years of age at the time, had turned the control of his important Columbia River canning interest over to his sons, but finding idleness not to his liking, started this cannery in order to have something to occupy his time. He operated it for several years and then abandoned the project.

In 1912 the Chetlo Harbor Packing Co. established a cannery at Chetlo Harbor, but operated it only that year and in 1914.

In 1919 only two canneries, both of them at South Bend, operated on Willapa Harbor.

COLUMBIA RIVER.

The Columbia, which is the largest river of the Pacific coast, rises in British Columbia, flows through Washington, reaching the northern border of Oregon about 75 miles west of the State's eastern boundary: from this point the river forms the dividing line between Oregon and Washington, its general course being westerly. It empties into the Pacific at Cape Disappointment. Its principal tributaries are the Spokane, Yakima, Snake, John Day, Deschutes, and Willamette Rivers, and through these the main river drains an enormous extent of territory.

This river, which has produced more salmon than any other river in the world, has had a most interesting history. Many years before the white man saw its waters the Indians visited its banks during the annual salmon runs and caught and cured their winter's supply of food. Along the shores of the river at The Dalles for 15 miles were notable fisheries where various bands, who lived south and north, had their respective fishing locations, and to which all others were forbidden access. They used spears and dip nets in catching the salmon, the majority of which were dried and smoked for winter use. This dip, or basket, net was fastened to a pole about 30 feet long and slid on a hoop. The Indian filled it by slinging it as far as possible up the stream and then hauling it up, the weight of the fish closing the net by drawing it on the hoop.

A favorite preparation of the Indians who resorted to the river was pemmican. This was the meat of the salmon cleaned of the bones, pounded up fine, and then packed in hempen sacks of home manufacture. A sack of pemmican weighed from 80 to 90 pounds and was worth in barter as much as an ordinary horse.

Capt. Wilkes, U. S. N., has the following to say with respect to salmon fishing by natives at Kettle Falls on the Columbia River near the present city of Colville, Wash., at the time of his visit there in 1841:

There is an Indian village on the banks of the great falls, inhabited by a few families, who are called "Quiaripi" (basket people, from the circumstance of their using baskets to catch their fish (salmon). The season for the salmon fishery had not yet (in June ?) arrived, so that our gentlemen did not see the manner of taking the fish; but, as described to them, the fishing apparatus consists of a large wicker basket supported by long poles inserted into it and fixed in the rocks. The lower part, which is of the basket form, is joined to a broad frame spreading above, against which the fish in attempting to jump the falls strike and are thrown back into the basket. This basket during the fishing season is raised three times in the day (24 hours), and at each haul not unfrequently contains 300 fine fish. A division of these takes place at sunset each day under the direction of one of the chief men of the village, and to each family is allotted the number it may be entitled to; not only the resident Indians, but all who may be there fishing, or by accident, are equally included in the distribution.^a

The first American to engage in fishing on the Columbia River was Capt. Nathaniel J. Wyeth, of Massachusetts, who in 1832 crossed overland to Oregon with the purpose of establishing salmon fisheries in connection with prosecuting the Indian and fur trade. He dispatched a vessel via Cape Horn to the Columbia with trading goods, but she was never heard from after sailing. In the meantime Wyeth

^a Narrative of the United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, and 1842. By Charles Wilkes, U. S. Navy, commander of the expedition. In 5 volumes. Vol. IV, pp. 444, 445. Philadelphia, Lea & Blanchard, 1845.

had established a station at Fort Hall, on the Lewis River, a branch of the Columbia.

In 1833 Capt. Wyeth returned overland to Boston, while the rest of his party dispersed throughout the Columbia Valley. Far from disheartened by the disaster to his vessel, Capt. Wyeth dispatched the brig *May Dacre*, Capt. Lambert, laden with trading goods and supplies, to the Columbia River via Cape Horn, while he crossed overland with 200 men. He established a salmon fishery and fort at the lower end of Wappatoo (now Sauvies) Island, at the mouth of the Willamette River.

The salmon fishery did not prove successful and the brig sailed in 1835 with only a half cargo of fish and did not come back. The same year Capt. Wyeth broke up both the establishment here and on the Lewis River and, disheartened, returned to Massachusetts, having found the competition of the Hudson Bay Co. too powerful for him.

In August, 1840, Capt. John H. Couch, in command of the brig *Maryland*, which belonged to Cushing & Co., of Newburyport, Mass., arrived in the Columbia River. After taking a few salmon the vessel left in the autumn never to return. On April 2, 1842, Capt. Couch reappeared in the river with a new vessel, the *Chenamus*, named after the chief of the Chinooks. With his cargo of goods he established himself at the present site of Oregon City, the first American trading house to be established in the Willamette Valley. He also established a small fishery on the Columbia River. The vessel returned to Newburyport in the autumn.

The next American vessel to come in established a far from enviable record. There is no record of her name, but she was commanded by a man named Chapman and entered the river April 10, 1842. She came for the purpose of trading and fishing and remained till autumn. During her presence in the river it is charged she sold liquor to the Clatsop and other savages, as a result of which much bloodshed and discord resulted.

About 1857 John West began salting salmon in barrels at Westport, on the lower Columbia.

In February, 1859, the Washington Legislature passed an act prohibiting nonresidents from taking fish on the beach of the Columbia between Point Ellis and Cape Hancock.

Bancroft ^a states:

On the 26th of January, 1861, J. T. Lovelace and W. H. Dillon were granted the exclusive right to fish in the Columbia for a distance of 1 mile along its banks and extending from low-water mark half a mile toward the middle of the stream.

In 1861, H. N. Rice and Jotham Reed began packing salted salmon in barrels at Oak Point, 60 miles below Portland. The first season's pack amounted to 600 barrels. The venture proved fairly profitable and was soon participated in by others.

In the spring of 1866 William Hume, who had assisted in starting the first salmon cannery in the United States on the Sacramento River in 1864, finding the run of fish in the latter stream rather disappointing, started a cannery for Hapgood, Hume & Co. on the Columbia at Eagle Cliff, Wash., about 40 miles above Astoria.

^a History of the Pacific States, Washington, Idaho, and Montana, 1845-1889, vol. 26, p. 349. By Hubert Howe Bancroft.

The year this first cannery operated the following fishermen were operating in the river: Jotham Reed used a trap and a small gill net opposite Oak Point; Mr. Wallace fished a small seine from the shore of an island of that name a short distance below; John T. M. Harrington (who was later to establish the Pillar Rock cannery), in conjunction with a man named Fitzpatrick, operated a seine at Tenasillie, as did also a Mr. Welch; P. J. McGowan, who, with his sons, in 1884 started a cannery at McGowan, and later, at Warrendale, Ilwaco, etc., operated two small seines at Chinook Beach; and Hapgood, Hume & Co. had two small gill nets about 125 fathoms in length and 32 meshes deep. The gill net of Mr. Reed was much smaller than these. At this period the river literally swarmed with salmon, and the cannery had no trouble in packing 4,000 cases, which it increased to 18,000 the next year and to 28,000 cases in 1868.

In 1867 a crude cannery on a scow was started by S. W. Aldrich, a ship carpenter. The scow was about 50 by 20 feet, with a cabin on it, and in one end of this he constructed a brick furnace in which he set a large cast-iron cauldron for a cooker. Along one side he rigged a bench and manufactured the cans. Aldrich was a regular jack-of-all-trades, as he did everything from catching the fish to canning and cooking them ready for the market.

In 1868 a cannery was built near Eagle Cliff by one of the Humes, while in 1873 R. D. Hume built another at Bay View, Wash. He operated it until 1876, when Mr. Leveridge, of Leveridge, Wadhams & Co., of San Francisco, bought it and operated it during 1877 and 1878. George W. Hume took it then and a few years later sold it to David Morgan, jr., who got into financial difficulties, and the plant was ordered sold by the court. C. W. Fulton, of Astoria, later a United States Senator, had the matter in charge, but was unable to find a customer, and finally in desperation offered it to W. H. Barker, of George & Barker, for \$600. Mr. Fulton closed with him the same day. It proved a most profitable transaction for the purchasers, who acquired a million and a half labels which could be utilized, the machinery was taken out for other plants, the timber on the land belonging to the tract sold, and the floating property sold for a considerable sum, after which the stripped plant and land were sold back to Mr. Morgan for \$600, the purchase price. He sold it to George W. Hume, who wanted it to correct a title. It was sold for taxes a couple of years later and was bought in by B. A. Seaborg, who operated it for two years, since when it has been idle.

George W. Hume was the first salmon canner to employ Chinese. This was at Eagle Cliff in 1872. At this period the white laborers in the canneries were recruited from the riffraff and criminal element of Portland. He had a Chinese working for him and through this man secured a Chinese gang from Portland. This labor proved so satisfactory that the custom soon spread to the other canneries. It was not found that the Chinese could do the work any better or quicker than the white laborer, but they proved more reliable in their work and gave less trouble.

Donald and Kenneth Macleay, of Portland, and William Corbitt, of San Francisco, who were in business in Portland, were the first to make a direct shipment of canned salmon to Liverpool. This

was in 1871, and the shipment abroad that year amounted to 30,000 cases.

Of the 35 canneries on the Columbia River in 1881, it is said that about one-half had been established by the Hume brothers. G. W. and William Hume were partners in the firm of Hapgood, Hume & Co., on the Sacramento River, and established the first cannery on the Columbia. In 1881 William was the proprietor of two canneries, one at Astoria, Oreg., and one at Eagle Cliff, Wash. R. D. Hume, a third brother, in the same year had a cannery in operation on the Rogue River, and established three others, one at Eagle Cliff (then owned by William Hume), one at Rainier (then belonging to Jackson & Myers), and one at Astoria. The fourth brother, Joseph, came to the coast in 1871 and some time later established a cannery on the river.

One of the pioneer canners on the river was the late F. M. Warren, operating as the Warren Packing Co., who established a cannery at Cathlamet, Wash., in 1869. The same company is still operating the plant. Later another cannery was established at Warrendale, Oreg., and it also is still operated by this company. Mr. Warren was the inventor of a retort, patented on April 10, 1877, which was in use by the principal canneries on the coast for a number of years.

John West was another pioneer. He built a cannery at Hungry Harbor, Wash., about 1869. In 1881 he moved his plant to Westport, on the Oregon side of the river. Mr. West was the inventor of a packing machine for placing the fish in the cans.

In 1871 the firm of Megler & Jewett established a cannery on the present site of Brookfield, Wash., and named it in honor of Mrs. Megler's birthplace, North Brookfield, Mass. In 1876 the plant was greatly enlarged and J. S. Megler bought out his partners and took in Mr. Macleay, of Corbitt-Macleay, wholesale grocers, of Portland and San Francisco, and changed the firm name to J. S. Megler & Co., under which title it still operates. In 1879 Mr. Megler bought out this partner and owned the plant until his death in 1915, since when it has been operated by his widow.

The first soldering machine used on the Columbia River was in this plant, while the steam box and lacquering machines were first put in use on the river in this plant.

In 1874 the Adair brothers, S. D. and John, jr., erected a cannery at Astoria, the second one to be built there. Before packing began, A. Booth, the well-known Chicago fish dealer, and progenitor of the present Booth Fisheries Co., acquired a half interest in the plant, which was then named A. Booth & Co. John Adair, jr., was the manager. The brothers established canneries on the Fraser River and in some seasons exchanged places in operating on the two rivers. S. D. Adair sold out his cannery on the Fraser and bought one on the Columbia and operated it under the firm name of S. D. Adair & Co. After selling out his interest in A. Booth & Co., S. D. Adair formed a partnership with Wm. B. Adair under the style of S. D. Adair & Co. in 1881. The brothers were active in the industry for a number of years.

J. O. Hanthorn, under the firm name of J. O. Hanthorn & Co., established one of the largest canneries on the river at Astoria in 1876. He invented a rotary can washer for washing cans after they were filled ready for soldering and before the tops were put on.

In the same year Marshall J. Kinney began his long and interesting career in the canning business by establishing a cannery at Astoria.

One of the most noted men the Columbia River produced was Mathias Jensen, a Dane, who fished there for some years. He achieved especial fame from his important inventions in canning machinery. His first invention, however, was a machine for filling needles for knitting salmon nets. He next invented a can-filling machine, which is in common use to-day. He also invented the first topping machine, which was a marked success. The patent rights of both these machines were sold to the Alaska Packers Association. The machines were all made at the plant of the Astoria Iron Works, at Astoria, of which Mr. John Fox was the founder.

The first fish trap or pound on the river was constructed by Mr. Graham, in Baker Bay, on the Washington shore in 1879. In 1881 Mr. P. J. McGowan built some traps just below the bay. The traps were very successful at times.

The first purse seine on the river was operated by William Graham & Co. in 1906.

Below appears a list of the canneries operated on the Columbia River in 1881, together with the pack of each during the year in question:

| | | | |
|-----------------------------------|--------|-----------------------------------|---------|
| J. Williams (Oregon side)..... | 9,000 | F. M. Warren..... | 12,000 |
| Astoria Packing Co. | 30,000 | J. West..... | 12,000 |
| Elmore Packing Co. | 7,890 | Jackson & Myers (2 canneries) . . | 13,000 |
| Astoria Fishery (M. J. Kinney). . | 26,000 | Aberdeen Packing Co. (Wash- | |
| Wm. Hume..... | 20,000 | ington Territory side)..... | 17,000 |
| Geo. W. Hume..... | 18,000 | Jos. Hume, Knappton..... | 20,225 |
| Devlin & Co..... | 20,000 | Pillar Rock Co..... | 15,000 |
| Occident Packing Co..... | 15,000 | J. G. Megler & Co..... | 25,000 |
| West Coast..... | 15,000 | Columbia Canning Co..... | 8,000 |
| Badollet & Co..... | 25,000 | R. D. Hume & Co..... | 8,300 |
| Booth & Co..... | 23,000 | Cathlamet Cannery..... | 8,000 |
| Eagle Cannery..... | 17,300 | Jas. Quinn..... | 5,000 |
| Timmins & Co..... | 8,000 | Cutting & Co..... | 20,000 |
| Fishermen's Packing Co..... | 19,000 | Eureka Packing Co..... | 20,000 |
| S. D. Adair & Co..... | 10,000 | Hapgood & Co..... | 13,000 |
| Anglo-American Packing Co..... | 10,300 | Eagle Cliff Cannery..... | 10,000 |
| Hanthon & Co..... | 19,000 | | |
| Scandinavian Co..... | 20,000 | Total..... | 549,115 |
| J. W. & V. Cook..... | 30,000 | | |

An interesting compilation prepared by the Portland Board of Trade ^a shows the total product in cases, the price per case of 48 pounds, and the price for each fish paid by the canneries to the fishermen from 1866 to 1881:

| Year. | Total product. | Price. | Cost of fish. | Year. | Total product. | Price. | Cost of fish. |
|-----------|----------------|---------|---------------|-----------|----------------|--------|---------------|
| | | | <i>Cents.</i> | | | | <i>Cents.</i> |
| 1866..... | 4,000 | \$16.00 | 15 | 1874..... | 350,000 | \$6.50 | 25 |
| 1867..... | 18,000 | 13.00 | 15 | 1875..... | 375,000 | 5.60 | 25 |
| 1868..... | 28,000 | 12.00 | 20 | 1876..... | 450,000 | 4.50 | 25 |
| 1869..... | 100,000 | 10.00 | 20 | 1877..... | 460,000 | 5.20 | 25 |
| 1870..... | 150,000 | 9.00 | 20 | 1878..... | 400,000 | 5.00 | 25 |
| 1871..... | 200,000 | 9.50 | 22½ | 1879..... | 480,000 | 4.60 | 50 |
| 1872..... | 250,000 | 8.00 | 25 | 1880..... | 530,000 | 4.80 | 50 |
| 1873..... | 250,000 | 7.00 | 25 | 1881..... | 550,000 | 5.00 | 60 |

^a The Commerce and Industries of the Pacific Coast of North America, pp. 372, 373. By John S. Hittell. San Francisco, 1882.

The banner year in the canning industry was 1884, when 620,000 cases of chinook salmon were marketed. At this time the runs were so enormous that tons and tons of salmon were thrown overboard by the fishermen because the canneries were unable to handle them.

As in other sections, there came a time when the market began to be glutted by the packs of the numerous canneries, and it was found necessary to combine some of the plants in order to operate more cheaply and also to reduce the output.

In 1885 W. H. Barker and George H. George, who had been connected with various canneries, formed a partnership as George & Barker and purchased the Astoria cannery of the Port Adams Packing Co., then 2 years old.

Shortly before this a combination which was named the Eureka & Epicure Packing Co. had been formed and comprised the following plants: Knappton Packing Co., Knappton; North Shore Packing Co., just below Knappton; and the Eureka Packing Co. This combination got into financial difficulties, and the reorganizers persuaded George & Barker to join the combination and take charge.

In 1887 the Eureka & Epicure Packing Co., the plants of Samuel Elmore, M. J. Kinney, and J. W. Seaborg, all of Astoria; J. O. Hanthorn & Co., Astoria; Fishermen's Packing Co., Astoria; Scandinavian Packing Co., Astoria; Columbia Canning Co., and J. W. & V. Cook, Clifton, were combined under the name of the Columbia River Packers Association. In 1889 the association built a new cannery at Rooster Rock. Mr. George was with the association until his death, but Mr. Barker left it to become general manager of the British Columbia Packers Association, where he is at present, the dean of the Pacific coast cannerymen.

Early in the eighties the California Can Co. was engaged in the business of making cans in San Francisco. Later the Pacific Sheet Metal Works absorbed the company. A factory was started at Astoria, with Mr. F. P. Kendall in charge. The latter, who is one of the deans of the industry, has had a long and interesting connection with all branches of the industry and in most sections. The American Can Co. later on bought the Pacific Sheet Metal Works, and the Astoria plant was moved to Portland.

The American Can Co. was the first to install sanitary can-packing machinery in the salmon industry, the venture being made in 1911, at the Sanborn-Cutting plant in Astoria.

At the present time (1919) there are 21 canneries in operation on the river, while large quantities of salmon are also frozen, mild cured, pickled, smoked, and sold fresh in the markets of the world.

Commercial fishing is carried on mainly between the mouth of the Columbia and Celilo, a distance of about 200 miles, and in the Willamette River. The most of it is in the lower part of the river, within about 40 miles of its mouth. Bakers Bay, on the Washington or north side, and just within the river's mouth, is the favorite ground for pound-net fishing. The principal gill-net drifting ground is from the river's mouth to about 20 miles above Astoria, but drifting is done wherever convenient reaches are found much farther up the river. Most of the drag seines are hauled on the sandy bars in the river near Astoria, which are uncovered at low water. Wheels are operated in the upper river above the junction of the Willamette with the main river.

Astoria is the principal center for all branches of the industry, but more especially for canning. Other places in addition to Astoria at which canneries are located are Ilwaco, Eagle Cliff, Altoona, Brookfield, Pillar Rock, Cathlamet, on the Washington shore, and at Warrendale, Rooster Rock, and Seuferts, on the Oregon shore.

OREGON.

Necanicum Creek.—This short stream is in Clatsop County and enters the Pacific Ocean about 10 miles south of the Columbia River. Its fisheries are of small importance.

Nehalem River.—The Nehalem is a small coastal river that rises in the mountains of Clatsop and Columbia Counties, and flows into the Pacific Ocean in the northern part of Tillamook County. As early as 1887 there was a small cannery here, and the business has been followed ever since. In 1911 an additional plant was built and both have operated each year since, except in 1913, when one was shut down.

Tillamook Bay and River.—Tillamook River is a very short stream which enters Tillamook Bay, the latter being in Tillamook County and about 45 miles south of the mouth of the Columbia River.

Fishing is carried on mainly in the bay. The earliest record we have of canneries on this bay is of 1886, when two were in operation. From 1891 to 1910 but one was operated, but in 1911 another plant was started. In 1915 a third cannery was built, and all three operated until 1918, when only one was in operation. In 1919, two operated.

Nestugga River.—This stream enters the ocean in the southwestern part of Tillamook County. A cannery operated here in 1887 and the business has been carried on each season with but one intermission since 1905.

Siletz River.—This river has its source in the mountains of Polk County and enters the ocean in the northern part of Lincoln County. The commercial development of the fisheries was hampered for many years owing to the fact that the river was within the boundaries of what was then the Siletz Indian Reservation. The first cannery was established here in 1896. An additional one was built in 1918.

Yaquina Bay and River.—The Yaquina ("crooked") River is about 60 miles long; its general course is nearly west through the county of Benton. The river is narrow throughout the greater part of its length. A few miles from its mouth it suddenly broadens out into an estuary from one-half to three-fourths of a mile wide, which is commonly called Yaquina Bay. The river enters the Pacific about 100 miles south of the Columbia.

Salmon canning was begun on this river in 1887, when two small canneries were constructed. The next year an additional plant was erected. The business has fluctuated considerably since then and there is now but one cannery, which has not been operated since 1911. In 1917 this plant was consolidated with the one at Waldport.

The fishing grounds are all in the bay and the lower section of the river. The fishermen of this section are fortunate in that they have railroad communication with the outside world.

Alsea Bay and River.—Alsea River rises in the southwestern part of Benton County, and flows in nearly a northwesterly direction to

the Pacific, a distance of about 60 miles. Like the Yaquina, the "bay" is merely a broadening out of the river just inside its mouth.

The first cannery was established in 1886 and by 1888 there were three in operation. For many years but one was operated. In 1911 and each season since two canneries have been operated.

The best fishing grounds are from the mouth of the river to about 5 miles inland.

Siuslaw River.—This river has its source in the mountains of Lane County, and its course lies first in a northwesterly direction and to the westward until the Pacific is reached. Through part of its course it is the dividing line between Lane and Douglas Counties. In 1915 a railroad line from Eugene to the mouth of the Siuslaw River, at which point it connected with a line to the Coquille River, was opened for traffic.

As early as 1878 there were two canneries operated on this river, but from 1879 till 1888 there are no data available showing the extent of the fisheries. In 1888 the Florence Canning Co., the Lone Star Packing Co., and the Elmore Packing Co. each operated a cannery. In 1896 A. W. Hurd built a cannery which was destroyed by fire in 1908. At present there are two canneries, but of recent years only one has been operated. The opening of a railroad line from Eugene to here, thus furnishing an outlet for fresh salmon shipments, will doubtless greatly help in developing its fisheries.

The salmon fishing grounds extend from near the mouth of the river to about 20 miles upstream.

Umpqua River.—With the exception of the Columbia this is the largest and longest river in Oregon. It is formed by north and south forks, which unite about 9 miles northwest of Roseburg, and the river then flows northwestwardly and enters the Pacific. Practically all of this river is within the boundaries of Douglas County, one of the largest counties in the State. A railroad has recently been built along this river and in time there will doubtless be a large development of the fisheries of this region owing to the opportunities which will be offered for shipping fresh fish.

With the exception of Rogue River, this is the only river in Oregon south of the Columbia River in which a spring run of chinook salmon occurs.

As early as 1878 there were two canneries located on the Umpqua, one of which was built by George W. Hume. The number has never been larger than this, and usually there has been but one operating. In 1912 there was but one at Gardiner. In 1919 one was operated.

In 1918 the Reedsport Fish Co., of Reedsport, purchased the cannery of the Umpqua Cooperative Co., at Gardiner.

Coos Bay and River.—Coos Bay is a navigable semicircular inlet of the ocean with numerous arms or branches. There is much marshy ground in the bay, and a number of sloughs, or small creeks, which empty into the bay from both sides. Coos River proper is an unimportant stream, but a few miles in length. North Bend, Marshfield, and Empire are the principal towns on the bay. A branch railroad is being built to these points from the main line of the Southern Pacific Railway, and as soon as this is completed the fishing industry will receive a great impetus. Heretofore this region has depended upon steamers and sailing vessels plying to Portland and San Francisco for its communication with the outside world, and

this slow and infrequent means of shipment has very seriously handicapped the fisheries.

Salmon canning began here in 1887, when two canneries opened for business. The business has fluctuated considerably since, most of the time but one cannery being operated; none was operated in 1919.

Fishing is carried on mainly in the bay. A few set nets are operated in the river.

Coquille River.—This river is formed by three branches, called the North, Middle, and South Forks, which rise in the Umpqua Mountains and unite near Myrtle Point, the head of tidewater, about 45 miles by river from the mouth of the stream. It is a deep and sluggish river, with no natural obstructions to hinder the free passage of fish. Its fisheries have been seriously hampered by the lack of railroad communication, but this has recently been remedied, as the railroad to Coos Bay connects with a short line now in existence between the Coquille River and Coos Bay, and thence on to the Siuslaw and from there to Eugene.

The principal towns on the Coquille River are Bandon, Prosper, Coquille, and Myrtle Point. Bandon is the shipping port.

Pickled salmon were cured and shipped from this river very early, the first recorded instance of any considerable quantity being in 1877, when 3,000 barrels of salmon were sent to San Francisco. The salt shipments were important until within recent years. The first salmon cannery was erected in 1883, at Parkersburg. In 1886 another was built at the same place, and the following year still another was erected close by. This was the largest number ever in operation in any one year. Since 1909 two canneries have been operated, both at Prosper. In 1916 the Macleay estate took over the Coquille River Fishermen's Cooperative Co.'s cannery near Bandon.

The fishing grounds are from the mouth to Myrtle Point, about 45 miles inland.

Sixes River.—This small river is located in the northern part of Curry County, and is about 40 miles in length, entering the Pacific a very short distance above Cape Blanco. The salmon caught here are either salted or shipped fresh to the canneries on the Coquille River.

Elk River.—This is another small stream about 40 miles in length, which enters the Pacific just south of Cape Blanco. As on the Sixes River, the salmon are either salted or sold fresh to the canneries on the Coquille River.

Rogue River.—This river has as its source Crater Lake in the Cascade Mountains, on the western border of Klamath County, flowing a distance of about 325 miles to the ocean, which it enters at Wedderburn. Its principal tributaries are the Illinois, Applegate, and Stewart Rivers. Owing to canyons and falls in the main river between the mouth of the Illinois River and Hellgate, the latter near Hogan Creek which runs through the town of Merlin, navigation and fishing are impossible in that section. Except at the mouth of the river the population is very sparse until about the neighborhood of Hogan Creek, where the river approaches the railroad, and from here on for some miles there are numerous growing towns.

Owing to the fact of there being both a spring and a fall run of salmon in this river, the fisheries early became of importance,

although sadly hampered because of being compelled to depend wholly on vessel communication with San Francisco, many miles away. In the early years the salmon were pickled and shipped to San Francisco. Strong, Baldwin & Co. started in the business as early as 1859. In 1877 R. D. Hume, who had been canning salmon on the Columbia River, removed to the Rogue River, and established near the mouth a cannery which he operated every season (except 1894, when the cannery burned down) until his death in November, 1908, after which date it was operated by his heirs. Mr. Hume also operated a large cold-storage plant at Wedderburn for several years.

The development of the fisheries of the lower Rogue River was very much hampered by the monopoly which Mr. Hume acquired and maintained until his death. He bought both shores of the river for 12 miles from its mouth, and also owned an unbroken frontage on the ocean shore extending 7 miles north from the mouth of the river. As a result of this, independent fishermen could find no convenient places for landing, which was necessary in order to cure, handle, and ship the fish caught. Since Mr. Hume's death the property has been sold to the Macleay estate, but the people of Oregon, upon an initiative and referendum petition, voted in 1910 to close Rogue River to all commercial fishing, and it was so closed in 1911 and 1912 but reopened in 1913. A second cannery was built here in 1915 by the Seaborg Canning Co.

In the upper river ranchers living along the banks have engaged in fishing for a number of years, the catch for the most part being sold fresh. In recent years, as the country has developed, this fishery has become fairly important.

Chetco and Windchuck Rivers.—These two unimportant streams empty into the Pacific in the lower part of Curry County, not far from the California line. The former is about 20 miles and the latter about 25 miles in length. Both have runs of salmon, and small fisheries have been maintained for some years, the catch being either pickled or sold to the California canneries.

CALIFORNIA.

Smith River.—This river, which is the most northerly one in the State, rises near the Siskiyou Mountains, and runs in a westerly direction to the Pacific Ocean.

The river has only a spring run of salmon, and the early recorded history of the fisheries is fragmentary. The pickling of salmon was the main business at first and has been important ever since, as the cannery, which was first established in 1878, operated irregularly, and seems to have shut down entirely in 1895. Canning began again in 1914 by H. E. Westbrook and has been prosecuted each year since.

Klamath River.—This is the most important river in California north of the Sacramento. It issues from the Lower Klamath Lake in Klamath County, Oreg., and runs southwesterly across Siskiyou County, passes through the southeastern section of Del Norte County, keeping its southerly course into Humboldt County, where it forms a junction with the Trinity River, and thence its course is directed to the northwest until it reaches the Pacific Ocean.

The Klamath River is important as a salmon stream because it has both a spring and fall run of salmon. In 1888 a cannery was estab-

lished at Requa, at the mouth, and this has been operated occasionally ever since. The pickling of salmon has been done here for a number of years. Some years part of the catch has been shipped fresh to the cannery on Smith River or to the Rogue River (Oreg.) cannery. Since 1908 the cannery has been operated continuously by the Klamath River Packers Association.

Humboldt Bay and tributaries.—The shore line of Humboldt County is bold and high, except in the vicinity of Humboldt Bay, where it is rather flat. The latter is the only harbor along the county shore, and it is quite difficult of access, owing to the bar at the entrance upon which the sea breaks quite heavily. The bay is about 12 miles long and about 3 miles wide. Mad River, which has its rise in the lower part of Trinity County, runs in a northwesterly direction, then makes a sharp turn and enters the bay from the north side. Eel River, which has its rise in Lake County, far to the southeast, runs in a northwesterly direction and enters the bay at its southern extremity. Small railroads running south from Eureka traverse the shores of both rivers for some miles. A railroad now runs from the north side of San Francisco Bay to Eureka, and it has aided very materially in extending the market for salmon caught in these rivers.

Mattole River.—This is a small and unimportant river in the southern part of Humboldt County, and is said to have a good run of salmon each year, but no commercial fishing has as yet been carried on here.

Noyo River.—In 1915 salmon fishing began at Fort Bragg, in Mendocino County, where the Noyo River debouches into the ocean. The building of a branch railroad to this point made the shipping of salmon a possibility. In 1915 and 1916 considerable salmon were caught and shipped fresh. In 1917 the Tillamook Ice & Cold Storage Co., built and operated a cannery here, while the Columbia & Northern Fishing & Packing Co., in the same year built and operated a cold-storage and mild-curing plant.

Sacramento and San Joaquin Rivers.—These two rivers are the most important rivers in California. The Sacramento is quite crooked, the distance by river from Red Bluff to San Francisco being about 375 miles, while the distance by rail between these two places is only 225 miles. The river rises in several small lakes in the mountains about 20 miles west of Sisson, in Siskiyou County, and for nearly half its length flows through a narrow canyon. The upper portion is a typical mountain stream, with innumerable pools and rapids. A little above Redding the river emerges from the canyon and widens into a broad shallow stream. Below Sacramento it runs through a level country and is affected by tides. Sloughs are numerous in this stretch, some connecting it with the San Joaquin. The Sacramento and San Joaquin Rivers join as they empty into Suisun Bay.

The principal tributaries of the Sacramento which are frequented by salmon are the Pit and McCloud Rivers and Battle Creek. At one time salmon frequented the American and Feather Rivers, but mining and irrigation operations along these streams either killed them off or drove them away.

The San Joaquin River has its source in the Sierra Nevada Mountains. Flowing westerly and forming the boundary between Fresno and Madera Counties for a considerable distance, it then turns abruptly to the north just where it is joined by Fresno Slough, which

drains Lake Tulare. From here its general course is northwesterly until it joins the Sacramento River, near the latter's mouth. The Chouchilla and Fresno Rivers are the principal tributaries of the San Joaquin.

The principal fishing grounds for salmon are Suisun Bay, the lower part of San Joaquin River, and the Sacramento River as high as the vicinity of Sacramento. Drift gill nets are used almost exclusively in this section. From Sacramento to Anderson there is considerable commercial fishing, more particularly with haul seines.

Owing to the early and excellent railroad facilities which the fisheries of the Sacramento River have enjoyed, they have not been handicapped so seriously as most of the other Pacific coast rivers in finding profitable outlets for the catch. Soon after the first trans-continental line was opened the shipping of fresh salmon to eastern points began, and it has been an important feature of the industry ever since.

The chief event in the history of the salmon fisheries of this river is the fact that the canning of salmon on the Pacific coast had its inception here in 1864. The circumstances leading up to this event and its consummation are interestingly told by R. D. Hume in the following words:

The first salmon cannery of the United States was located at Washington, Yolo County, Calif. A part of the building was originally a cabin situated on the river bank outside of the levee just opposite the foot of K Street, Sacramento City. It was built in 1852 and occupied by James Booker, Percy Woodsom, and William Hume. William Hume came to California in the spring of 1852, bringing with him a salmon gill net which he had made before leaving his home at Augusta, Me. In company with James Booker and Percy Woodsom, Mr. Hume began fishing for salmon in the Sacramento River just in front of the city of Sacramento. William Hume had been salmon fishing in the Kennebec River in the State of Maine with his father, where his father and grandfather had been engaged in the same business since 1780, and their ancestors in Scotland had for pleasure pursued the sportive salmon on the Tweed and Tay for centuries before. In 1856 William Hume went back to Maine, and on his return to California the same year was accompanied by his brothers, John and G. W. Hume, who also engaged in salmon fishing in the Sacramento River. Among the schoolmates of G. W. Hume was one Andrew S. Hapgood, who had learned the tinsmith's trade, and who a short time after G. W. Hume left for California went to Boston and entered the employ of J. B. Hamblen, a pioneer in the canning business, and was sent by him to Fox Island on the coast of Maine to engage in canning lobsters. The canning of lobster was a new and growing industry, and Mr. Hamblen, to increase his business, a short time after sent Mr. Hapgood to the Bay of Chaleur, an arm of the sea which divides the Province of Quebec from that of New Brunswick, where, in addition to the canning of lobster, they also canned a few salmon. I believe this was the first salmon canned on the American Continent, and I am informed that the business in a small way is still carried on in that section of the country. In 1863 G. W. Hume went back to Maine, and while there visited Mr. Hapgood at Fox Island, to which place he had been again sent by J. B. Hamblen to take charge of the works at that place. During the visit of G. W. Hume to his friend Hapgood a talk about salmon was had, and it was agreed that if salmon on the Pacific coast were as plentiful as represented by Mr. Hume much money could be made in a salmon-cannery business. The plan decided on was that G. W. Hume, on his return to California, should try and induce his brother William to engage in the business with them, and, if he succeeded in so doing, Mr. Hapgood should purchase the necessary machinery and come out to California in time for the spring season of 1864. William Hume being agreeable to take part in the enterprise, Mr. Hapgood set out on the journey and arrived at San Francisco on March 23, 1864, and a few days later at the location where the operations were afterwards conducted.^a

* * * * *

^a The description of the machinery used and the methods of canning have been quoted in full under "Canning" elsewhere in this report.

For a considerable time after the salmon-canning business was inaugurated the packers suspended operations in the early part of July of each year as at that time the market would take only goods which showed a rich oil and the best food values.^a

The business languished after the firm established its cannery on the Columbia River, but in 1874 was renewed again by others and continued with varying success until 1905, when it ceased temporarily, owing to the smaller quantity of fish available and the difficulty of competing with the mild-cure packers and the fresh-fish dealers. Several times since small packs have been made when, for some reason, mild-curing was unprofitable.

Monterey Bay.—The first harbor south of San Francisco is Monterey Bay, a large indentation cutting into Santa Cruz and Monterey Counties. Only a portion of it is well sheltered, however. For a number of years it had been known that salmon frequented the waters of this bay for the purpose of feeding on the young fishes which swarmed there. Sportsmen frequently caught them with rod and reel, but it was not until the early eighties that the industry was established on a commercial basis. It has since grown very rapidly. The catch has either been mild cured at Monterey or shipped fresh. A few have been canned in recent years.

ALASKA.^b

Alaska is the most favored salmon-fishing region. Many rivers, some of great length and draining enormous areas, intersect the district in every direction, while the number of small creeks is countless. Almost every one of these have runs of salmon of varying abundance. The principal streams entering Bering Sea are the Yukon, Kuskokwim, Togiak, Nushagak, Kvichak, Naknek, Ugaguk, and Ugashik; in central Alaska the Chignik, Karluk, Alitak, Susitna, and Copper Rivers are the main streams, while in southeast Alaska are found, among many others, the Anklow, Situk, Alsek, Chilkat, Chilkoot, Taku, Stikine, and Unuk Rivers. Most of the fishing in Alaska is carried on in the bays into which these rivers debouch. In southeast Alaska, which is composed largely of islands, the fishing is carried on mainly in the bays, sounds, and straits among these.

Even before the purchase of the district from Russia in 1867 our fishermen occasionally resorted to southeast Alaska and prepared salted salmon. The salmon fisheries did not become important, however, until canning was begun.

SOUTHEAST ALASKA.

One of the most favorable sections for carrying on fishing operations is southeast Alaska. Here a narrow strip of mainland, about 30 miles wide, separates British Columbia from salt water and forms the "panhandle" of Alaska. Outside this is a fringe of numerous islands, large and small, close to the coast line, conform-

^a The First Salmon Cannery. By R. D. Hume. Pacific Fisherman, Seattle, Wash., Vol. II, No. 1, January, 1904, pp. 19-21.

^b The material for the history of the salmon fisheries of Alaska for the period from the inception of salmon canning to 1900 was obtained almost wholly from the following excellent and valuable reports by Capt. Jefferson F. Moser, to whom I am deeply indebted for this and other valuable data:

The Salmon and Salmon Fisheries of Alaska. Report of the Operations of the United States Fish Commission Steamer *Albatross* for the Year ended June 30, 1898. By Jefferson F. Moser. Bulletin, U. S. Fish Commission, 1898, Vol. XVIII, pp. 1-178. Washington, 1899.

Alaska Salmon Investigations in 1900 and 1901. By Jefferson F. Moser. Bulletin, U. S. Fish Commission, 1901, Vol. XXI, pp. 173-398. Washington, 1902.

ing to its irregularities and separated from it and from each other by deep straits and channels. These islands, about 1,100 in number, extend from the coast an average distance of about 75 miles and along the general contour for about 250 miles. Some of these islands are very large, indented with deep bays and sounds, and they in turn fringed with smaller islands.

The largest streams in this region are the Unuk, Stikine, Taku, and Chilkat, all of which take their source in the interior and drain considerable areas. The other rivers are usually streams, and the greater number are simply outlets to a lake or system of lakes.

All species of salmon are to be found in this region, but the hump-back is by far the most abundant.

This region has been the favorite fishing ground for the smaller operators, although a few of the largest canneries in Alaska are located here. Of recent years transportation facilities have been exceedingly good and fairly cheap, while the nearness to the States and the considerable resident population which could be drawn upon for labor have been big factors in its development.

The Russians did considerable salting of salmon. Petroff, in his report in the Tenth Census on the "Population, industries, and resources of Alaska," writes as follows of the Redoubt near Sitka: "The once famous Redoubt or deep-lake salmon fishery on Baranof Island, which at one time during the Russian rule supplied this whole region, and whence 2,000 barrels of salmon were shipped in 1868, now lies idle."

Bancroft^a in speaking of the king salmon of Alaska says: "So choice is its flavor, that during the régime of the Russian American Co. several barrels of the salted fish were shipped each season to St. Petersburg for the use of the friends of the company's officials."

One of the earliest operators in southeast Alaska was a Greek, or Slav, named Baronovich, who married the daughter of Skowl, one of the old-time chiefs of the Kasaans, and received from him the fishery on Karta Bay, a part of Kasaan Bay, and one of the best red salmon streams south of Wrangell Narrows. Baronovich built a saltery here, kept a store and traded with the Indians. He died some years ago, and for some time after his death his sons operated it. It finally collapsed a couple of years ago.

For a number of years a saltery was operated at Klawak, on the west coast of Prince of Wales Island. In 1878 the North Pacific Trading & Packing Co. purchased the saltery and erected the first cannery in Alaska here. A pack was made the same year, and the plant has operated every year since. In 1899 the cannery burned down, but it was immediately rebuilt on the opposite side of the bay. For some years this plant was operated almost exclusively with native labor, and at present the majority employed are natives.

The same year that the above cannery was established the Cutting Packing Co. built a cannery at old Sitka, and operated it in 1878 and 1879, then it was closed down. In 1882 the machinery was taken by another company to Cook Inlet.

In 1882 M. J. Kinney, of Astoria, under the name of the Chilkat Packing Co., built a cannery on the eastern shore of Chilkat inlet and made a pack the same year. The cannery changed hands several times

^a History of Alaska, Vol. XXXIII, p. 661. By Hubert Howe Bancroft. San Francisco, 1886.

and finally was burned in 1892, and not rebuilt. The cannery packed every year from 1883 to 1891, both inclusive, except in 1888, when it was closed.

In 1883 the Northwest Trading Co. built a cannery on Pyramid Harbor, a little bay on the western side of Chilkat Inlet. It was operated by this company in 1883 and 1884, was idle in 1885, and in 1888 was sold to D. L. Beck & Sons, of San Francisco, and operated by that firm. In the spring of 1889 it was burned, but was rebuilt at once and a pack made that year. In 1893 it joined the Alaska Packers Association, which operated it, except in 1905, until the end of the season of 1908, when it was finally abandoned.

On the north shore of Boca de Quadra, about 8 miles from the entrance, a cannery was built in 1883 by M. J. Kinney, of Astoria, and operated under the name of the Cape Fox Packing Co. from 1883 to 1886. Late in the last-named year it was sold and moved to Ketchikan, operating there under the name of the Tongass Packing Co. during 1887, 1888, and until August, 1889, when it was burned and not rebuilt.

In 1886 Rhode & Johnson erected a saltery at Yes Bay. The following year the firm became Ford, Rhode & Johnson. In 1887 work was begun on a cannery which was finished in 1888. Packing was begun in 1889 under the name of the Boston Fishing & Trading Co. In 1901 it was included in the Pacific Packing & Navigation Co. consolidation, and when that concern failed was purchased in 1905 by the Northwestern Fisheries Co. In 1906 the cannery was purchased by C. A. Burkhardt & Co., who have operated it each year to date, either under that name or subsequent incorporations known as the Yes Bay Canning Co. and the Alaska Pacific Fisheries.

In 1887 the Aberdeen Packing Co. of Astoria, Oreg., built a cannery on the Stikine River, about 8 miles above the mouth. In 1889 the cannery was moved to Point Highfield, on the northern end of Wrangell Island, and operations commenced under the name of the Glacier Packing Co. In 1893 it joined the Alaska Packers Association, who have operated it continuously, except in 1905.

The Loring cannery of the Alaska Packers Association was built in 1888 by the Alaska Salmon Packing & Fur Co., of San Francisco, and operated by the Cutting Packing Co. The company was incorporated in 1883 and operated a saltery until the cannery was built. When the Alaska Packers Association was formed in 1893 it joined that organization. The cannery has operated every year since it was built, and in some seasons has made the largest pack of any in the Territory.

Shortly after William Duncan and his community of Tsimpsen Indians had settled, in 1887, on Annette Island, which island had been set aside by the Federal Government as a reserve for them, plans were under way for a salmon cannery, but funds came in so slowly that it was not until 1890 that any pack was attempted. In 1891 it was in full operation, and operated from then continuously until 1913, when the plant was shut down for that and the two succeeding years. Much dissatisfaction had been expressed by the natives over the operation of this and other industrial plants on the island, and finally the Federal authorities took possession of practically everything, as guardian of the natives, and early in 1916 leased the cannery to P. E. Harris & Co., of Seattle, the understanding being that they were to employ natives when available. Un-

fortunately the plant burned down on May 17, just before the fishing season began. In 1918 the Annette Island Packing Co. built and operated a cannery here.

For the purpose of assisting the natives of Annette Island in operating this cannery the President in 1916 issued a proclamation making a fishery reserve of the island and among other things provided that—

the waters within 3,000 feet from the shore lines at mean low tide of Annette Island, Ham Island, Walker Island, Lewis Island, Spire Island, Hemlock Island, and adjacent rocks and islets, located within the area segregated by the broken line upon the diagram hereto attached, and made a part of the proclamation, also the bays of said islands, rocks, and islets, are hereby reserved for the benefit of the Metlakatlans and such other Alaskan natives as have joined them or may join them in residence on these islands, to be used by them under the general fisheries laws and regulations of the United States as administered by the Secretary of Commerce.

One white trap net owner refused to remove his trap from the waters in question, and when decision was rendered against him in the lower court, carried the case to the United States Supreme Court, which, in December, 1918, upheld the right of the President to grant exclusive fishing rights in public waters.

James Miller operated a saltery on Burroughs Bay, on Behm Canal, in 1886 and 1887. In 1888 Andrew and Benjamin Young, of Astoria, Oreg., built a cannery here and operated it under the name of the Cape Lees Packing Co. in 1888, 1889, and 1890. It was closed in 1891 and 1892. In 1893 it became a part of the Alaska Packers Association, and was dismantled the following year.

About 1888 a saltery was established on Thorne Bay, Prince of Wales Island. The following year it was sold to the Loring cannery. In 1892 it was sold to Robert Bell, who moved it to the upper end of the northwest arm, on the western shore. Salting was not carried on each season, as it was sometimes found to be more profitable to sell the fish fresh to the canneries. The plant was finally abandoned.

In 1889 Messrs. Sanborn and Ellmore, of Astoria, built a cannery in Pavlof Harbor, Freshwater Bay, on the eastern side of Chichagof Island, and operated it under the name of the Astoria & Alaska Packing Co. It made a pack that year and in the spring of 1890 was moved to Point Ellis, on the eastern side of Kuiu Island, packing that year and also in 1891. It was burned in May, 1892. Only one building was left standing, and it and the site were purchased by John H. Mantle, of Wrangell, who operated a saltery on each arm of the bay. Mr. Mantle began operations here in 1893.

In 1889 the Baranof Packing Co. built and first operated a cannery at the Redoubt, about 12 miles below Sitka. It was also operated in 1890 and then moved to Redfish Bay, on the western coast of Baranof Island. It made its first pack here in 1891 and was then operated every year until 1898, when it was sold to the Alaska Packers Association and dismantled.

In 1889 the Thlinket Packing Co., organized at Portland, Oreg., built a cannery at Point Gerard, on the mainland opposite Point Highfield, at the head of Wrangell Island. It was operated that and the subsequent year.

In 1901 this company built another cannery at Santa Anna, on the north side of Cleveland Peninsula, and made a pack the same year.

In 1901 both plants became part of the Pacific Packing & Navigation Co. In 1902 the Gerard Point plant was closed and was not opened again. In 1903, 1904, and 1905 the Santa Anna plant was closed also. Early in 1905 these plants were purchased by the Northwestern Fisheries Co. at the assignee's sale of the old corporation's properties. The Santa Anna plant was operated in 1906 and has been operated each year since.

The Chilkat Canning Co. put up a plant at Chilkat village, on Chilkat Inlet, in 1889. It was operated from 1889 to 1893, and then sold to the Alaska Packers Association. It was held in reserve for some years but was finally dismantled.

In 1889 D. Blauw, of Tacoma, Wash., built a saltery on Grouse Island, Boca de Quadra, and dry-salted dog salmon. He operated only one season.

In 1890 a cannery was built by the Bartlett Bay Packing Co. on Bartlett Bay, Icy Straits, and operated by Williams, Brown & Co., of San Francisco. A saltery was constructed here prior to that date, and in 1889 a pack of 4,300 cases was made in a crude way. In 1891 the ice piled up in Glacier Bay to such an extent that the cannery could do almost nothing. It was not operated after this date. In 1893 it became a part of the Alaska Packers Association and was dismantled in 1894.

About 1890 a saltery was established on the north shore of the mouth of Quadra Stream, on Boca de Quadra, by Clark & Martin. It was operated intermittently until about 1898, when it was abandoned. The same parties also established a saltery at Ketchikan shortly after the one on Quadra Stream was built, and operated this until about 1898, when the plant was turned into a steamer wharf and warehouse for the new town of Ketchikan which was building up around it.

In 1896 the Pacific Steam Whaling Co. built a cannery on the northern side of Hunter Bay, near the southern end of Prince of Wales Island, and made a pack the same year. Miller & Co. had a saltery at this place and it was purchased by the company and removed to make room for the cannery. Miller & Co. also had a saltery on Nutqua Inlet, which was built in 1896, and this also was sold to the canning company. In 1901 the cannery became a part of the Pacific Packing & Navigation Co. It was closed in 1904. Upon the dissolution of the company in 1905 this plant was purchased by the Northwestern Fisheries Co., which company, after keeping it closed in 1905 and 1906, has operated it each season since.

The Quadra Packing Co. built a cannery on Mink Arm, in Boca de Quadra, in the spring of 1896 and made its first pack that year. In 1901 the plant was purchased by the Pacific Packing & Navigation Co. It was closed in 1904, 1905, and 1906. Upon the dissolution of the company in 1905 the plant was purchased by the Northwestern Fisheries Co. It was reopened in 1907 and has been operated each season since.

In 1897 a saltery was built on Taku Point, near the head of Taku Inlet. In 1898 and 1899 it was operated by the Quadra Packing Co. In 1900 the Icy Straits Packing Co. operated it.

In 1897 a small saltery was in operation by Cyrus Orr at Point Barrie, Kupreanof Island. In the same year Walter Kosmikoff

operated a small saltery at Shipley Bay, on Prince of Wales Island. In 1900 he sold it to the Icy Straits Packing Co.

Fred Brockman in 1897 built and operated a small saltery on Sarkar Stream, Prince of Wales Island. Mr. Brockman operated this saltery intermittently until his death in 1915.

In 1897 Bauter & West were operating a saltery at Sukkwan, on Sukkwan Island. In the same year Miller & Co. started another saltery on Kassook Inlet, on Sukkwan Island, while Thomas McCauley was operating a saltery on Whale Passage.

In 1899 the Icy Straits Packing Co., consisting of stockholders of the Quadra Packing Co., built a cannery and sawmill at a point on the southeastern shore of Wrangell Narrows, about a mile south of the northern entrance to same, and named the town site Petersburg. The cannery was ready and operated in 1900. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1903, 1904, and 1905. In 1905 it was purchased at the sale of the company's properties by the Northwestern Fisheries Co. In 1906 the Pacific Coast & Norway Packing Co., which had been operating a cannery at Tonka, on Wrangell Narrows, purchased this plant and transferred its activities to the latter. In 1915 the plant was leased to the Petersburg Packing Co., composed of stockholders of the old company.

In 1900 the Western Fisheries Co., of Portland, built a cannery at the head of Dundas Bay, and made a pack the same year. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1904. At the assignee's sale of the company's properties in 1905 this plant was purchased by the Northwestern Fisheries Co. and operated in 1905 and each subsequent year.

In 1900 the Fidalgo Island Packing Co. built a cannery on the southern side of Ketchikan Creek. A pack was made the same year. The plant was closed in 1903, only a little salting being done that year, was reopened in 1904, was closed again in 1905, and was reopened in 1906, since when it has been operated each season to date, except in 1909.

In 1900 the Pacific Coast & Norway Packing Co. operated a floating saltery while prospecting for a cannery location. In 1901 the company built a cannery at Tonka, about midway of Wrangell Narrows, on the western side, and made a pack in that and subsequent years until 1906. In that year the company purchased the Petersburg cannery and thenceforth operated from there. The Tonka plant was dismantled a few years later.

In 1900 the Royer-Warnock Packing Co., of San Francisco, built a small cannery on Beecher Pass, which connects Duncan Canal with Wrangell Narrows, using the old Buck saltery for the cannery proper. It operated only the one season. It was a hand-pack plant.

The Taku Fishing Co. in 1900 built a cannery on the southern side of the entrance to Port Snettisham, and made a pack in that year. In 1901 it became a part of the Pacific Packing & Navigation Co. The plant was closed in 1902 and not reopened again.

In 1900 the Taku Packing Co., organized in Astoria, Oreg., built a cannery on the western shore of Taku Inlet and made a pack the same year. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1904 and not reopened again. In 1905 it became the property of the Northwestern Fisheries Co.

In 1900 the Chilkoot Packing Co., organized at Aberdeen, Wash., built a cannery at the head of Chilkoot Inlet, and operated the same year. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1904 and not reopened again.

In 1900 the Great Northern Fish Co. operated a floating saltery. Its principal business was salting dog salmon for the Japanese trade, and it operated only one season. J. E. Rice, of Whatcom, Wash., in the same year packed dog salmon on Karta Bay for the same trade.

The Pacific Packing & Navigation Co. (an account of whose inception, operation, and failure appears under Puget Sound) was organized in 1901 and acquired the following canneries in Alaska: Canneries of Pacific Steam Whaling Co. at Nushagak, Bristol Bay; Chignik, Alaska Peninsula; Uyak, Kodiak Island; Kenai, Cook Inlet; Orca, Prince William Sound; Hunter Bay, southeast Alaska. Also the Hume Bros. & Hume canneries at Chignik and Uyak; the Thlinket Packing Co. with canneries at Gerard Point and Santa Anna; the Western Fisheries Co. cannery at Dundas Bay, Icy Straits; Chilkoot Packing Co. cannery at Chilkoot Inlet; the Taku Packing Co. cannery at Taku Inlet; the Taku Fishing Co. cannery at Port Snettisham; the Boston Fishing & Trading Co. cannery at Yes Bay; the Chatham Straits Packing Co. cannery on Sitkoh Bay; the Icy Straits Packing Co. cannery at Petersburg, Wrangell Narrows; and the Quadra Packing Co. cannery at Mink Arm, Boca de Quadra.

The company met with financial disaster in 1904, and at the resulting sale most of its properties were bought by the Northwestern Fisheries Co., a corporation formed for the purpose. Of the Alaska canneries the Sitkoh Bay plant was sold to George T. Myers & Co., while the Orca plant was leased to Capt. Omar J. Humphreys, from whom the Northwestern Fisheries Co. later on secured it.

The San Juan Fishing & Packing Co., of Seattle, established a cannery and cold-storage plant in 1901 at Taku Harbor, a small bay on the mainland a short distance south of Taku Inlet, and made a pack the same year. This plant was purchased in 1903 by the Pacific Cold Storage Co. and operated by it in 1903, 1904, and 1905. In 1906 it was leased and operated by the Taku-Alaska Packing Co. From 1907 to 1911 the plant was leased and operated by John L. Carlson & Co. In 1911 the plant was purchased by Mr. Carlson and the name changed to the Taku Canning & Cold Storage Co., under which name it has been operated each year since. In 1918 it was purchased by Libby, McNeill & Libby.

In 1901 the Chatham Straits Packing Co. built a cannery on Sitkoh Bay, Chichagof Island. The same year this cannery became a part of the Pacific Packing & Navigation Co. Upon the dissolution of the latter, early in 1905, this plant was purchased by George T. Myers & Co., which company has operated it to date without a break.

In 1901 F. C. Barnes, of Portland, Oreg., built a cannery at Lake Bay, on the east side of Prince of Wales Island, and made a pack that season. This cannery was operated in 1902, but was closed in 1903. It was reopened in 1904, and operated each season after that. In 1910 it was incorporated under the name of F. C. Barnes Co.

In 1901 the Union Packing Co., organized in Tacoma, Wash., built a cannery on Kell Bay, an arm of Afleck Canal, on the southern side

of Kuin Island. In 1904 this plant was moved to the Kvichak River in Bering Sea.

Buhring & Heckman operated a small saltery in Union Bay, on the north side of Cleveland Peninsula, in 1901. Packing was carried on aboard a barge.

In 1901 the Muir Glacier Packing Co. put up a saltery on Ideal Cove, Dry Pass, near Wrangell. It has operated mainly as a mild-cure station. It was closed down in 1903 but was opened in 1904. It was then closed in 1905, 1906, and 1907. It was opened in 1908 by K. J. Johansen and operated in 1908 and 1909.

In 1902 the Kasaan Bay Co. built a cannery on the north side of Kasaan Bay, Prince of Wales Island, and made a pack the same year. It was shut down in 1904 and 1905, but reopened in 1906 by Gorman & Co., of Seattle, who had purchased control of the company. Shortly after the closing of the packing season the plant burned down, but it was rebuilt in time to operate the following season. In 1909 the plant was closed, but was reopened in 1910. On September 12 of that year the plant was again destroyed by fire, but was rebuilt in time to operate the following season. On October 29, 1911, the plant was once more destroyed by fire, but was rebuilt in time to operate in 1912. In 1915 the plant was purchased and operated by the Anacortes Fisheries Co., a subsidiary of the Booth Fisheries Co.

In 1902 the Alaska Fish & Lumber Co. built a cannery at Shakan, on Kosiushko Island, near the head of Prince of Wales Island, and made a pack the same year. It was shut down in 1904. In 1905 the property was taken over by the Shakan Salmon Co., a new company composed largely of members of the old corporation, who operated it that season. In 1906 Gorman & Co., of Seattle, obtained control of this cannery and operated it each season under the name of the Shakan Salmon Co. until 1915, when it was sold to the Anacortes Fisheries Co., a subsidiary of the Booth Fisheries Co.

In 1902 the Columbia Canning Co. built a cannery on the southern side of Chilkoot Inlet, and made a pack that year. In 1910 C. A. Burekhardt & Co., under the name of the Chilkoot Fisheries Co., purchased and operated this plant. In 1911 the name was changed to the Alaska Pacific Fisheries. Early in 1919 the plant was totally destroyed by fire.

The only cannery in this section lost to Alaska by action of the Federal Government was that of the Wales Island Packing Co., which was built on Wales Island, near Dixon Entrance, in 1902. When the Alaska Boundary Arbitration Commission declared Wales Island a part of Canada in 1903, this cannery automatically ceased to be an American one. After the change of government it lay idle for some time, but is now in use once more by Canadian parties.

In 1902 the Thlinket Packing Co. built a cannery on Funter Bay, on the west side of Admiralty Island, and made a pack that year and every subsequent year to date.

The same year the Pillar Bay Packing Co. built and operated a cannery near Point Ellis, on Kuin Island, and operated it until 1918, when it was sold to the Fidalgo Island Packing Co.

In 1902 the Alaska Fisheries Union, organized in Seattle, built a cannery on the east side of Chilkat Inlet, and made a pack that year. After operating in 1905, the plant was in that year leased to and operated by the Lynn Canal Packing Co. The plant was purchased

in 1906 by the Pacific American Fisheries. In 1908 it was moved to Excursion Inlet and has been operated each season to date.

The Tacoma Fishing Co. in 1902 established a saltery and halibut station at Tee Harbor, on Lynn Canal, and made a pack that year. Later it became the property of the International Fisheries Co. In 1910 the plant was purchased by the Tee Harbor Packing Co., which established a cannery and operated first in 1911. It has been operated each season since, being sold to the Alaska Pacific Fisheries Co. in 1920.

The Seattle-Scandinavian Fish Co. built a saltery on Snug Harbor, Tenakee Inlet, Chichagof Island, in 1902, and made a pack. It packed in 1903 also, but shut down in 1904. The plant was leased in 1905, and then shut down for good.

The Alaska Fish & Mining Co. built and operated a saltery at Revilla, on Tongass Narrows, during the single season of 1902, while the Rice Fisheries Co., in the same year, built and operated a saltery on Boca de Quadra.

The United Fish Co., of Seattle, salted at Tolstoi Bay, east side of Prince of Wales Island, 1903 and 1904.

In 1907 the Alsek Fisheries Co. did some salting on the Alsek River. Malcolm Campbell was interested in the above company and in subsequent years operated under his own name. In 1910 the St. Elias Packing Co. established a cannery near the saltery and made a pack the same year, and in 1911 and 1912. Since then the plant has been closed and was sold in 1916 to Libby, McNeill & Libby.

The Astoria & Puget Sound Packing Co., in 1908, built and operated a cannery on Excursion Inlet. It was closed the following year, but has been operated each year since. It was burned in 1917, but was rebuilt in time to operate the following season.

The year 1911 witnessed a considerable increase in the number of canneries. Among the new plants built and operated were the following: Hidden Inlet Canning Co., Hidden Inlet, Portland Canal; Hawk Fish Co. (later changed to P. E. Harris & Co.), Hawk Inlet, Admiralty Island; Lindenberg Packing Co., Roe Point, Behm Canal; Deep Sea Salmon Co., Cape Edwards, Chichagof Island; L. Gustave & Co., Skowl Arm, Prince of Wales Island (changed in 1912 to Skowl Arm Packing Co.), and M. E. Lane (a small hand-pack plant), Myers Chuck, Cleveland Peninsula.

An innovation in Alaska salmon canning this year was when the old ship *Glory of the Seas* was fitted out as a floating cannery by the Alaska Fish Co., and operated in Hawk Inlet, Admiralty Island, and at Ketchikan. Quarters for the crew were built over the cabins on the quarter deck, the latter being reserved for officials. The remainder of the upper deck was used for receiving, dressing, and cleaning the fish, which were brought on board by means of a portable elevator attached to the side of the ship. The "iron chink" and the sliming and cleaning tanks were also on this deck. The fish were carried in chutes to the second deck, where a line of sanitary machinery had been installed. The retorts were placed on the forward part of the second deck. The third deck was used for cooling and storing the pack. No lacquering or labeling was carried on aboard the vessel.

In 1912 this plant and the ship *William H. Smith*, the latter by the Weiding & Independent Fisheries Co., of Seattle, were operated. The *William H. Smith* also did some freezing of salmon.

In 1913 the *Glory of the Seas* was sold to the Glacier Fisheries Co., which operated it as a cold-storage plant. The floating cannery and cold-storage ship *William H. Smith* was not operated in Alaska during this season.

In 1912 still more canneries were built, among these being the following: Admiralty Trading Co., Gambier Bay, Admiralty Island; Alaska Sanitary Packing Co., Wrangell; Canoe Pass Packing Co., Canoe Pass; Herbert Hume Packing Co., Nakat Inlet, Portland Canal; Hoonah Packing Co., Hoonah, Icy Straits; Irving Packing Co., Karheen; Kake Packing Co., Kake; Kuui Island Packing Co., Point Beauclaire, Kuui Island; Lindenberger Packing Co., Craig, Fish Egg Island; Oceanic Packing Co., Waterfall; Point Warde Packing Co., Point Warde, Bradfield Canal; Pure Food Fish Co., Ketchikan; Revilla Fish Products Co., Ketchikan; Sanborn-Cram Co., Burnett Inlet; Starr-Collinson Packing Co., Moira Sound; Sunny Point Packing Co., Cholmondeley Sound; Swift, Arthur & Co., Heceta Island; Walsh-Moore Canning Co., Ward Cove, and Wiese Packing Co., Rose Inlet.

In 1913 the plant of Swift, Arthur & Co. was used as a mild-cure station alone, while the name was changed to the Swift-Arthur-Crosby Co. The Alaska Fish Co. absorbed the Oceanic Packing Co. and transferred its activities to the former company's cannery at Waterfall. The following other plants were shut down: Canoe Pass Packing Co., Herbert Hume Packing Co., Point Warde Packing Co., and the Revilla Fish Products Co.

In 1914 one new cannery was built. This was erected on George Inlet, Revillagigedo Island, by the George Inlet Packing Co. The canneries of the Point Warde Packing Co., located at Point Warde, and the G. W. Hume Packing Co. (formerly the Herbert Hume Packing Co.), at Nakat Inlet, which were not operated in 1913, were reopened in 1914. The cannery of the Swift-Arthur-Crosby Co. was also reopened. The Walsh-Moore Canning Co. changed its name to the Ward Cove Packing Co., while the Sanborn-Cutting Co. took over the cannery operated by the Kake Packing Co. The canneries of the Admiralty Trading Co. and the Skowl Arm Packing Co. were closed in 1914. The plant of the Kuui Island Packing Co. burned down in the fall.

In 1915 the Admiralty Trading Co. did not operate. Late in the summer it was sold to the Hoonah Packing Co., which company operated it in 1916 and succeeding years. The new canneries in 1915 were the Doyhof Fish Products Co., at Doyhof, on Wrangell Narrows, and Edward Verney & Son (a hand plant), at Metlakatla. The name of the Irving Packing Co. was changed to the Karheen Packing Co. The Straits Packing Co. purchased the Skowl Arm cannery of the Skowl Arm Packing Co. and operated it.

In 1916 the following new canneries were constructed and put into operation: Auk Bay Salmon Canning Co., Auk Bay; Beegle Packing Co., Northland Packing Co., and J. L. Smiley & Co., all at Ketchikan; Sanitary Packing Co., George Arm; Seattle Packing Co., floating plant in Idaho Inlet; Tenakee Fisheries Co., Tenakee; and Union Bay Fisheries Co., Union Bay.

The George W. Hume Co.'s plant at Nakat Inlet, formerly operated by the Herbert Hume Packing Co., burned down shortly after the

season's operations had begun. It was rebuilt in time to operate in 1917.

Late in 1916 the Lindenberger Packing Co. sold its Roe Point plant to the Northwestern Fisheries Co. and its Craig plant to the Columbia Salmon Co. About the same time the Seattle Packing Co. disposed of its floating cannery *Amelia* to the Northland Fish Co., which operated it at Metlakahla in 1917. The Sanitary Packing Co. changed to the Ketchikan Packing Co., while the Sunny Point Packing Co. took over all the interests of the Northland Packing Co., and in 1917 operated the cannery also located at Ketchikan.

In 1917 the heavy demand throughout the world for foodstuffs caused a considerable increase in the number of new canneries in Alaska. In the southeast Alaska section, nine were built and operated as follows: Alaska Herring & Sardine Co., Port Walter; Alaska Pacific Herring Co., Big Port Walter; Baranof Packing Co., Red Bluff Bay; R. L. Cole & Co., Token; Haines Packing Co., Letinkof Cove; Lane & Williams, Moira Sound; Northland Fish Co. (floating plant *Amelia*), Metlakahla; Sitka Packing Co., Sitka; and Robert Scott, a floating cannery at Craig. The two first named were built in 1916 but were not then engaged in canning salmon.

On September 13, 1917, the cannery of the Sunny Point Packing Co., at Sunny Point, was totally destroyed by fire, while on October 2 the same fate befell the cannery of the Astoria & Puget Sound Canning Co. at Excursion Inlet. Wilson Fisheries Co., of Chicago, took over the J. L. Smiley & Co. plant at Ketchikan.

In 1918 the following new canneries were put into operation: Alaska Clam Canning Co., Petersburg; Alaska Packing & Navigation Co., Pavlof Harbor; Columbia Salmon Co., Tenakee Inlet; Hidden Inlet Canning Co., Hood Bay; Hunter & Dickinson, Washington Bay; T. E. P. Keegan, Douglas; J. H. Long Packing Co. and Northern Packing Co., Juneau; Noyes Island Packing Co., Noyes Island; Pybus Bay Fish & Packing Co., Pybus Bay; Pyramid Packing Co. and Sitka Packing Co., Sitka; Southern Alaska Canning Co., Quadra; Todd Packing Co., Peril Strait; and H. Van Vlack & Co., Petersburg.

The name of the Sanborn-Cram Co. was changed to Burnett Inlet Packing Co. The Deep Sea Salmon Co. established a new plant at Port Althorp and used part of the equipment of its former Knik Arm cannery in equipping it. G. W. Hume Co. purchased the Doyhof Packing Co. cannery at Scow Bay. The Marathon Fishing and Packing Co. operated the barge *Amelia* at Petersburg. The Southern Alaska Canning Co. took over the Rose Inlet plant of the Wiese Packing Co.

The following new plants were constructed and operated in 1919: Alaska Salmon & Herring Co., Tyee; Alaska Sanitary Packing Co., an additional plant at Cape Fanshaw; Beauclaire Packing Co., Port Beauclaire; Cape Fanshaw Fishing & Packing Co., Cape Fanshaw; J. L. Carlson & Co., Auk Harbor; Douglas Island Packing Co., Douglas; Hood Bay Packing Co., Hood Bay; Olympic Fisheries Co., floating barge at Ketchikan, etc.; Petersburg Packing Corporation, Washington Bay.

The Southern Alaska Canning Co. took over the Alaska Pacific Herring Co., while the Alaska Clam Canning Co. changed its name to the Mountain Point Packing Co. The American Packing Co. took over the J. H. Long Packing Co.

In 1919 the Northwestern Fisheries Co. did not operate its Santa Ana, Hunter Bay, and Roe Point canneries, while the Anacortes Fisheries Co. shut down its Shakan cannery. Other canneries which did not operate were the following: Craig cannery, of Columbia Salmon Co.; T. E. P. Keegan, Douglas.

At one time salteries were of considerable importance in this section, but the establishment of canneries, with the consequent heavy demand for fresh salmon, induced most of the salteries to sell their high-grade fish to the canneries and pack only the cheaper grades. Many of them quit the business as a result of the competition, while others were forced out by the low prices prevailing at times for salted salmon. As many of the salters moved from place to place, and frequently changed their operating name, it has been difficult to keep track of them, and in this review only those are listed who attained to some prominence either through longevity or largeness of pack.

James Millar, one of the earliest whites to take up his residence here after the purchase of Alaska, and his sons were very active in starting and operating salteries, and it was an unusual thing during the period previous to 1910 when one of the family was not operating such a plant.

Jacob Louth established a saltery on the south arm of Moira Sound about 1900 and operated it for some years.

John C. Frey established a saltery on Etoline Island in the nineties and ran it until his death in 1904, when John H. Mantle purchased and operated it until about 1910.

Anderson & King built a saltery on Cholmondeley Sound, Prince of Wales Island, in the nineties. In 1904 it was operated under the name of A. E. King. After Mr. King's death his widow operated it from 1906 to 1909. In 1910 the saltery was purchased by C. A. Burckhardt & Co., who built a cannery on the site and began operations in 1911. In 1912 the name was changed to the Alaska Pacific Fisheries.

The Alaska Fish & Development Co. built a saltery on Pleasant Bay, Admiralty Island, in 1903, and operated it from 1903 to 1905. In 1907 it was operated by the Alaska-American Fish Co., but has been closed since.

Yakutat Bay is the only harbor available for vessels from Cape Spencer to Prince William Sound. In 1902 C. A. Fredericks & Co., of Seattle; Mulvey & Wilson, of Yakutat; Jewell Fish Co.; and Ankow Fish Co. all established salteries here. While their primary purpose was the salting of herring, considerable salmon was also salted. These plants operated only the one season.

In 1904 the Yakutat & Southern Railway Co. built a cannery here. This plant is noted for being the only one that hauls its fish by railway from the fishing streams to the cannery. The railroad is a little over 9 miles in length, and for some years an engine which had seen service on the elevated railroads of New York City and was discarded when the latter were electrified was used. A more modern engine is now in use. The fish are carried in open freight cars. Later this company was purchased by Gorman & Co., and now is the property of Libby, McNeill & Libbey, although operated under the original name.

PRINCE WILLIAM SOUND AND COPPER RIVER.

The great indentation known as Prince William Sound, and the Copper River delta, a short distance south of the sound, were not exploited as much as many other portions of Alaska until about 1915, due largely to the limited means of transportation and the consequent heavy expense of operation.

The principal source of salmon supply is the Copper River, a glacial stream about 300 miles long, which empties into the Gulf of Alaska through a delta nearly 40 miles in width and extending upstream about 25 miles.

Owing to the constantly shifting shoals in the delta, special knowledge is needed in navigating them, while special flat-bottomed vessels are required as run boats. The gill net and dip net are the only important apparatus in use in the river. In Prince William Sound traps and purse seines catch most of the salmon.

In 1889 a company known as the Central Alaska Co. built a cannery on Wingham, or Little Kayak Island, about 15 miles west from Cape Suckling. It made a pack that year, and the following spring was moved to Thin Point, on the southern side of the Alaska Peninsula.

The Peninsula Trading & Fishing Co. built a cannery on the same island in 1889. In 1891 it was moved to one of the sloughs of the Copper River delta, known as Coquenhena, and operated in 1891. It was closed in 1892 and 1893. The Pacific Steam Whaling Co. operated it until 1897, when it was abandoned.

In 1916 the Hoonah Packing Co. built and operated a cannery on Bering River.

Louis Sloss & Co., of San Francisco, built a cannery under the title of Pacific Packing Co. in 1889 at the extreme eastern end of the sound, close by the present site of Cordova, and called it Odiak. The cannery was closed in 1892. In 1893 it joined the Alaska Packers Association and was operated each season until 1905. In 1906 the buildings and site were sold to the Copper River & Northwestern Railroad Co., which was preparing to build a railroad from Odiak to the headwaters of the Copper River.

In 1889 the Pacific Steam Whaling Co. built a cannery close by the Odiak plant, but in the spring of 1895 it was moved to the spot now known as Orca, about 3 miles north of Cordova. It was closed in 1892, and has been operated ever since except in 1919 and 1920. In 1901 it was taken into the Pacific Packing & Navigation Co. combination. When the latter's assets were sold in 1904, this cannery was not included in the sale, as at the time the plant was under lease to Capt. Omar J. Humphrey. In 1905 it was sold to the Northwestern Fisheries Co., which had purchased most of the Alaska plants of the defunct company, and they have operated it since.

In 1915 the Copper River Packing Co. built a cannery on the Copper River at Mile 55, and made a pack the same year. The cannery uses no run boats, but has an arrangement with the Copper River & Northwestern Railroad Co. to haul the fish from the fishing stations to the cannery, and bring the finished product to Cordova for shipment by steamer. In 1918 the name was changed to the Abercrombie Packing Co.

The Canoe Pass Packing Co., which had built a cannery at Canoe Pass, southeast Alaska, in 1912, and had not operated it subsequently, in 1915 moved the machinery to Cordova and installed it in a rented building and made a pack. It built its own cannery at Shepard Point, near Cordova, in 1917.

In 1916 the Carlisle Packing Co. built a cannery at Cordova, while the Clark-Graham Co. built one at Eyak, a few miles away.

In 1917 the following new canneries were operated: Valdez Packing Co., Valdez; Copper River Packing Co., Port Nellie Juan; Lighthouse Canning Co. and Moore Packing Co., Cordova; and San Juan Fishing & Packing Co., Seward. The latter plant was also equipped for freezing salmon and other fishes. The Lighthouse Canning Co. was canning clams in 1916, the first year of its operation. The Alaska Sea Food Co. took over the Turner cannery, which had been built in 1916 and used in packing clams. The plant was destroyed by fire on April 4, but was rebuilt the same year, although not operated with salmon until 1918.

A number of salmon salteries were started in Prince William Sound after 1915. Charles Matthews in 1916 operated a salmon saltery at Seward; The Kenai Fishing & Trading Co. in 1916 acquired the J. Bettles saltery on Eshamy Bay. In 1918 the company expanded into a canning plant. A. C. Hoodenpyle operated a saltery at Port Wells in 1918.

In 1919 the following new canneries were started: Franklin Packing Co., Port Ashton; and Pioneer Packing Co., Cordova (this plant had been operating on clams for a couple of seasons). The Eyak River Packing Co. took over the Clark-Graham Co., while the Hillery-Scott Co. succeeded the Lighthouse Canning Co.

COOK INLET.

While this great inlet has an abundant supply of salmon, it is one of the most difficult sections in all Alaska in which to fish successfully. The tides and currents in the inlet are strong and treacherous, increasing in height and force as its head is approached, where the tide comes in with a bore which is extremely dangerous to small craft. Shoals make out a long distance from shore and are continually changing.

The first cannery to be built on the inlet was in 1882, when the Alaska Packing Co., of San Francisco, built one at Kasilof, on the right bank of the Kasilof River at the mouth, utilizing the available machinery from the cannery built by the Cutting Packing Co. at old Sitka in 1878. In 1885 this cannery was sold to the Arctic Fishing Co. In 1890 the loss of its cannery ship forced it to close that season. In 1893 it joined the Alaska Packers Association. At the height of the season of 1905 the plant was burned. It was rebuilt the next spring and has been operated each year since.

The cannery of the Northern Packing Co. was built in 1888 on the eastern side of Cook Inlet, at Kenai, at the mouth of the Kaknu River. It was operated up to and including 1891. In 1893 it joined the Alaska Packers Association, but has not been operated since 1891.

In 1897 the Pacific Steam Whaling Co. built a cannery at Kenai, but did not install the machinery and operate it until the next year. In 1901 this cannery was taken over by the Pacific Packing & Navigation Co. In 1903 the plant burned down. Upon the sale of it

assets in 1905 the site passed to the Northwestern Fisheries Co. In 1910 the company put up a new plant here and has operated it continuously since. During the period when the site was unused a mild-curing establishment was operated here by the San Juan Fishing & Packing Co. in 1907 and 1908. This plant burned down just before the fishing season of 1916 began, but was rebuilt in time to operate in 1917.

In 1890 George W. Hume, of San Francisco, built a cannery at Kasilof, on the right bank of the river, about half a mile above its mouth. It was operated in 1890, 1891, and 1892. In 1893 it joined the Alaska Packers Association and was consolidated with the plant of the Arctic Fishing Co.

C. D. Ladd operated a saltery on the left bank and at the mouth of the Chulitna River, about 6 miles above Tyonek. This saltery was purchased by the Alaska Salmon Association in 1899. The following spring it erected a cannery here and made a small pack. It was operated also in 1901 and 1902, and then abandoned.

In 1907 J. A. Herbert & Co. established a saltery at English Bay and operated it until 1910.

In 1911 the Seldovia Salmon Co. built a cannery at Seldovia and operated it until late in 1915, when the company went into the hands of a receiver. In 1916 it was reopened by the Columbia Salmon Co. In 1917 it was bought by the Northwestern Fisheries Co. and operated in this and the succeeding year, but was closed in 1919.

In 1912 the Fidalgo Island Packing Co., which already operated a cannery at Ketchikan, in southeast Alaska, built a cannery at Port Graham, at the lower end of the Kenai Peninsula. A pack was made that year and each year since.

The same year Libby, McNeill & Libby built a cannery at Kenai and operated that year and each subsequent year.

In 1915 the Deep Sea Salmon Co., which operates a cannery in southeast Alaska, built a plant near Knik, on the west side of Cook Inlet, and made a small pack. This plant was abandoned at the end of 1917 and part of the equipment sold to a new plant in southeast Alaska.

Of recent years considerable salting of salmon has been carried on in Cook Inlet. In 1916 Dr. Knut A. Kyvig, of Anchorage, did some salting at Swanson Creek, Turnagin Arm, under the name of the Kyvig Packing Co. In 1917 the Beluga Whaling Co. salted salmon at Beluga. In 1918 Dr. Kyvig disposed of his interest in the Kachemak Bay plant to the Kachemak Canning Co.

AFOGNAK ISLAND.

Afognak Island lies to the northwest of Kodiak, and it is separated from it by a narrow strait.

In 1889 the Royal Packing Co. built a cannery at the head of Afognak Bay and operated it in 1889 and 1890. It became a member of the Alaska Packers Association in 1893. It has not been operated since 1892.

The Russian-American Packing Co. in 1889 built a cannery immediately above that of the Royal. It was operated in 1889 and 1890. In 1893 it became a member of the Alaska Packers Association. It has not been operated since 1890.

In accordance with an act of Congress approved March 3, 1891, the President, by proclamation of December 24, 1892, set aside the whole island and within 1 mile from the shores thereof as a fish-cultural reserve for the use of the United States Commission of Fish and Fisheries. As a result of this action both canneries were forced to move from the island entirely.

KODIAK ISLAND.

This island has been the scene of some of the best fishing in Alaska. The Russians early settled here, one of the most fertile spots in the usually sterile soil of Alaska, and undoubtedly they must have prosecuted the fisheries from an early date, although but little data are extant showing their operations in this line.

Karluk River and Lagoon.—One of the greatest salmon streams in the world is the Karluk River, and although its importance is much diminished now through long continued and heavy fishing, it still produces annually a large pack of canned-salmon, and has the distinction of having produced more salmon than any other river in Alaska.

It will doubtless surprise most readers to hear that the river which has yielded so many countless thousands of salmon is only $16\frac{1}{2}$ miles in length. It has its source in two lakes, the larger of which is about 8, the smaller, 3 miles long. The mouth of the river is about 2 miles above the canneries, and spreads out here into a lagoon. This lagoon has at the head a width of about 300 yards, and gradually widens until it is nearly half a mile across as it approaches the spit. The lagoon has a general east and west direction, is about 2 miles in length, and, except for the shingle spit which is thrown across its mouth by the action of the sea, its shores are bluff, rising from about 50 to 100 feet. The spit is three-fourths of a mile long with an average width of about 200 feet. The outlet of the lagoon is only 90 feet wide at its mouth. The western side of the mouth of the lagoon is Karluk Head, a precipitous mountain mass about 1,600 feet high.

The outer side of the spit is where the fishing is carried on. Haul seines are used exclusively. As bowlders used to be common here it was necessary to remove a number of them in the early days when a seine shore was to be prepared. The red salmon run here is an exceptionally long one, the season extending from about the middle of June to about the middle of September. The other species of salmon also run here; sometimes humpbacks appear in large numbers. As the beach is open to Shelikof Strait, in which storms are frequent, seining is often interrupted.

As early as 1867 the salting of salmon was carried on at Karluk. In 1870 the Alaska Fur Trading Co. and the Alaska Commercial Co. began to salt salmon and continued this on a gradually expanding scale.

In 1882 Smith & Hirsch, who had been engaged in salting on Karluk Spit, built the first cannery on Kodiak Island. After operating it until 1884 it was organized under the title of the Karluk Packing Co., and packed under that name every year until 1911, when canning operations were transferred to the new cannery in Larsen Bay. In 1893 it joined the Alaska Packers Association.

The Kodiak Packing Co. in 1888 built a cannery on the eastern side of the spit and operated it in 1888, 1889, 1890, 1891, and 1893. It joined the Alaska Packers Association in 1893, but has not been operated since that season.

The Hume Packing Co. built a cannery on the spit about 400 yards westward of Kodiak cannery in 1889. In 1892 it was consolidated with the Aleutian Islands Fishing & Mining Co., which had built a cannery about 100 yards westward of the Hume cannery in 1888. In 1893 the consolidation became a member of the Alaska Packers Association. This plant was not operated in 1900.

In 1888 the Alaska Improvement Co. built a cannery on the left bank of the outlet, opposite the point of the spit and facing the Shelikof Strait. It was ready to pack in 1888, but was not operated on account of the loss of its cannery ship, the *Julia Ford*. In the spring of 1897 it was sold to the Alaska Packers Association and has since been operated by that company.

In 1893 the Hume Canning & Trading Co. built a cannery on the beach under Karluk Head, about three-fourths of a mile northward of the Alaska Improvement Co., in what is known locally as Tanglefoot Bay. It was operated in 1893 and 1894, and in 1895 it was sold to the Alaska Packers Association and operated by that company. It has been closed since.

The great increase in the number of canneries in Alaska in 1888 and 1889 caused such an enlargement of the pack that the markets became glutted, and it was soon apparent that steps would have to be taken to reduce the output if the operators were to avoid bankruptcy.

Capt. Moser in "Salmon and Salmon Fisheries of Alaska"^a thus describes the attempts of the canners to find a working solution of this important problem and the final result of their endeavors:

In 1890 the three canneries at Chignik combined under an operating agreement known as the Chignik Bay Combination, under which the plant of the Chignik Bay Co. was operated, the three canneries sharing the expense and dividing the output equally. This arrangement remained in force during the seasons of 1890 and 1891. Its evident success in 1890 probably led to the local combinations on Kodiak Island in 1891, and then to the association which now exists.

The large packs during this period and the glutted market caused the cannery interests to devise some scheme to meet the conditions. The combination at Chignik in 1890 permitted the pack to be made there at a lower rate and, as previously stated, it was continued in 1891. The same year (1891) the canneries at Karluk, Uyak, and Afognak entered a combination, under the name of the Karluk River Fisheries, under which it was agreed that each cannery should have a quota of fish from the several localities, based upon the average packs of each cannery in 1889 and 1890. The estimated pack for the canneries interested was placed at 250,000 cases, and upon this estimate the apportionment of the work at each cannery was made. Under this agreement four of the eight canneries were closed, their quota being packed in the other four canneries as follows, viz, that of the Royal at the Karluk, of the Arctic at the Kodiak, of the Aleutian Islands at the Hume, and of the Russian-American at the Alaska Improvement.

In the summer of 1891 the Kodiak Packing Co. and the Arctic Packing Co., both at Alitak Bay, also had a mutual agreement under which only one cannery, the Arctic, was operated, the quota of fish of the Kodiak being packed in the Arctic cannery. By these combinations the full pack of the Karluk district was made in half the number of canneries and the expense of packing very considerably reduced.

In September, 1891, the Alaska Packers Association was formed to dispose of the unsold salmon of that season's pack (some 363,000 cases) and five trustees were ap-

^a The Salmon and Salmon Fisheries of Alaska. Report of the Operations of the U. S. Fish Commission Steamer *Albatross* for the Year ended June 30, 1898. By Jefferson F. Moser. Bulletin, U. S. Fish Commission, 1898. Vol. XVIII, pp. 18-21. Washington, 1899.

pointed to manage the business. This association was not incorporated and expired after the salmon were sold.

The successful operation of these arrangements led, in 1892, to an arrangement in which nearly all (31) of the canneries joined, entering under the name of the Alaska Packing (not Packers) Association, for the purpose of leasing and operating and therefore controlling the canneries and reducing the Alaska pack for that year, it being found too great for the market's demands. All the canneries in operating condition in 1892 were members of this association except the following: Metlakahla Industrial Co., at Metlakahla; Boston Fishing & Trading Co., at Yes Bay; Baranoff Packing Co., at Redfish Bay; Chilkat Canning Co., at Pyramid Harbor; Alaska Improvement Co., at Karluk; and the Bering Sea Packing Co., at Ugashik.

The association was regularly incorporated on January 13, 1892, and shares were distributed on the basis of 1 for each 2,000 cases packed in 1891, and the profits were divided equally on all shares, regardless of the amount of profits derived at the different points. Of the 31 canneries, 9 were operated by the association, while the others were closed, the Alaska pack being reduced one-half.

The year 1893 found the Alaska Packers Association organized and incorporated February 9. This association was formed from the canneries that had joined the Alaska Packing Association of 1892, except the Pacific Steam Whaling Co., at Prince William Sound, and the Peninsula Trading & Fishing Co., the latter's cannery having been moved from Little Kayak Island to the Copper River delta in 1891.

The agreement of 1893 was similar to that of 1892, except that the amount of profit was taken into consideration in addition to the probable average quantity which could be packed at the different points. This was subject to adjustment for each district, and no arbitrary rule was followed. Each cannery entering the association was obliged to purchase an additional amount of stock, equaling two-thirds of the number of shares received by it for its plant; that is, a company which received 1,500 shares for its plant was required to purchase 1,000 shares additional. The money received from this sale of extra stock was used as working capital. No shares were sold to the general public, the owners of canneries subscribing for the full amount.

This association was then and is now (1920) the largest operator in Alaska, and, with its three canneries on Puget Sound, is also a factor in that region.

At a number of its canneries the association has always maintained physicians, whose services and supplies have been free to its own employees and to all natives applying for medical advice and medicines. This service has been of incalculable benefit to the latter, a large proportion of whom suffer from disease in some form or other.

No canning has been done at Karluk since 1911, when a new cannery was built at Larsen Bay, a branch of Uyak Bay, and the equipment remaining in the plants on the spit removed to it. This was done because frequent storms had caused havoc to vessels anchored in the open straits opposite the mouth of the lagoon. Since then fishing has been carried on as usual, the fish being carried to the canneries on Uyak Bay. The Alaska Packers Association and Northwestern Fisheries Co., the only operators now, have an agreement to divide the fish on the basis of seven to the former for every three given to the latter.

Alitak Bay.—Alitak Bay, or the "South End," as it is termed locally, is a deep indentation, with several arms, on the southwestern end of Kodiak Island, about 65 miles from Karluk. The seine is the principal apparatus used here.

In 1889 the Arctic Packing Co. built a cannery in the southwest bight of Olga Bay, which is a branch of Alitak Bay and is connected with it by a long, narrow passage. In 1893 it entered the Alaska Packers Association.

In 1889 the Kodiak Packing Co. built a cannery at Snug Harbor, a cove in the passage connecting Olga Bay with Alitak Bay, and operated it in 1889 and 1890. Its quota of fish was packed by the

Arctic Packing Co. in 1891. In 1893 it joined the Alaska Packers Association and the same year was dismantled.

In 1918 the Alitak Packing Co. built a cannery on Alitak Bay.

Uyak Bay.—Uyak Bay is on the northwestern side about the middle of Kodiak Island and is a considerable body of water with ramifying arms. On the western shore, near the entrance and about 18 miles from Karluk, is Uyak Anchorage. The harbor is formed by the main shore of the island and Bear and Harvester Islands, and is frequently used as an anchorage by cannery ships and the steamers from Karluk during bad weather. As there are no red salmon streams in Uyak, fishing is carried on elsewhere. Most of it is at Karluk Spit.

In the spring of 1897 the Pacific Steam Whaling Co. and Hume Bros. & Hume built canneries on the main shores at Uyak Anchorage. In 1901 both plants became a part of the Pacific Packing & Navigation Co. and were operated by it. In 1905 the Uyak plants were purchased by the Northwestern Fisheries Co., and the same year one of the plants was destroyed by fire and was not rebuilt. The remaining plant has been operated each year since.

Five miles southeast from Uyak Anchorage is a narrow arm called Larsen Bay. It is 4 miles long. Immediately within the entrance on the northern shore is the site of the cannery of the Arctic Packing Co., which was built in 1888, and operated in that year and 1889 and 1890, since which date it has been closed. In 1893 it became a part of the Alaska Packers Association and in 1896 it was dismantled.

As the association had lost several ships while loading at Karluk, it finally decided to move its plants from that place, and in 1911 a cannery was built at the old site on Larsen Bay, and from that time all cannery operations formerly carried on at Karluk have been performed at this plant.

Uganuk Bay.—This bay is next to the eastward of Uyak. For several years a saltery was operated here by Oliver Smith, who sold it to the Alaska Packers Association in 1896. The same year the latter built a cannery on the bay. It made a pack in 1896 and a partial pack in 1897. This cannery was abandoned in 1900.

Kodiak.—Salting operations have been carried on at this old Russian settlement for a number of years.

In order to furnish work for the natives, the Alaska Commercial Co. and Blodgett & Blinn salted the catches made by them in 1906 and subsequent years until 1912, when the Kodiak Fisheries built a cannery and has operated it each year since.

The Woman's American Baptist Home Missionary Society had carried on a home and school for native children on Wood Island, close to Kodiak, for some years. In 1902 the society established a salmon saltery here in order to furnish employment for the natives. No data are recorded in the official reports of further activities on the part of this plant.

CHIGNIK BAY.

Chignik Bay is on the southern side of the Alaska Peninsula and is the first important indentation after leaving Cook Inlet on the way to the westward. The bay is about 150 miles southwest of Karluk. On the westward side of the bay is a small deep bay known as Anchorage Bay. Several of the canneries are located here, and the trans-

porting vessels of all the canneries make their anchorage at this point. In the extreme southwest corner of Chignik Bay is the entrance to Chignik Lagoon. At the head of this lagoon, from which all the canneries draw their supplies of red salmon, is the mouth of the stream up which go the schools.

Chignik River is about 6 miles long, with an average width of 100 yards, and its depth is such that a boat can ascend only at high water. It has its rise in two lakes, each about 10 miles long.

Red salmon predominate in the runs, although all five species are to be found. A run of very small red salmon, weighing about 2 pounds, and known as Arctic salmon, appears here every year.

Practically all of the fishing here is with traps, although gill nets and seines have also been used at times.

This bay, next to Karluk Spit, has been the scene of more bitter fights for supremacy in canning than any other place in Alaska.

In 1888 the Fishermen's Packing Co., of Astoria, Oreg., sent a party to Chignik Bay to prospect for fish, and they returned in the fall with 2,160 barrels of salt salmon.

The next year, this company, operating under the name of the Chignik Bay Co., built a cannery on the eastern shore of the Lagoon, $2\frac{1}{2}$ miles from the entrance.

The same year the Shumagin Packing Co., composed of capitalists from Portland, Oreg., and the Chignik Bay Packing Co., of San Francisco, built and operated canneries close to that of the Chignik Bay Co. All three of these companies soon arrived at a working agreement and finally combined into one organization. All were operated in 1889, 1890, and 1891. In 1892 they all joined the pool of the Alaska Packing Association, and the cannery of the Chignik Bay Co. alone operated. In 1893 they all became members of the Alaska Packers Association.

Since 1891 only the cannery of the Chignik Bay Co. has been operated. The Shumagin building has been moved alongside the former and the machinery consolidated, so as to form practically one large cannery.

In the spring of 1896 Hume Bros. & Hume built a cannery on the eastern side of Anchorage Bay and made a pack that year and in 1897.

The same spring the Pacific Steam Whaling Co. built a cannery one-fourth of a mile south of the Hume cannery, and made a pack that year and in 1897. In 1901 this plant, also that of Hume Bros. & Hume, became part of the Pacific Packing & Navigation Co. The failure of this company in 1904 threw its properties onto the market and most of them, including the two Chignik canneries, were purchased by the Northwestern Fisheries Co., which in 1905 shut down the Hume Bros. & Hume plant for good and has operated the other plant ever since.

In 1910 the Columbia River Packers Association built and operated a cannery on Anchorage Bay, and has operated it every year since.

The three companies operating here have an amicable agreement under which they each operate the same number of traps and divide equally the salmon caught.

ALASKA PENINSULA, SOUTH SIDE.

Ozernoy.—In 1889 a cannery, under the title of the Western Alaska Packing Co., was built at Ozernoy, on the western side of Stepovak Bay, south side of the Alaska Peninsula. It packed that year and in 1890, but the fish were so scarce that the cannery was dismantled in 1891 and the site abandoned.

Nothing was done with it for some years, but about 1905 Bostrop Omundsen located there and established a saltery. In the winter of 1912-13 August Lindquist purchased a half interest in the plant and it was operated under their joint names until the death of the senior partner in the fall of 1915; since then it has been operated by Lindquist alone.

Thin Point.—Thin Point is on the southern side of the Alaska Peninsula, near its extreme western end. A saltery was operated here for several years, until the Thin Point Packing Co. was organized by Louis Sloss & Co., of San Francisco, and the cannery was built in 1889. It was operated in 1889, 1890, and 1891, and was closed after that date. In 1890 the cannery ship *Oncida*, en route for this place, struck on the Sannaks in April and nearly all of the 77 Chinese on board were lost. In 1893 the plant became a member of the Alaska Packers Association. In 1894 the cannery was moved to the Naknek River, in Bering Sea, and became a part of the cannery of the Arctic Packing Co.

The Alaska Packers Association operated a saltery at Thin Point in 1894, 1895, and 1896, and then abandoned the place.

The cannery of the Central Alaska Co. was moved in 1890 from Little Kayak Island, near Katalla, to Thin Point. It operated during 1890 and 1891, was closed in 1892, and in 1893 joined the Alaska Packers Association, but was no longer operated. In 1895 the available machinery was moved to Koggiung, on the Kvichak River, in Bering Sea.

In 1908 Osmund & Andersen established a saltery at Thin Point and operated it in 1908, 1909, and 1910.

In 1911 the Pacific American Fisheries built a cannery at King Cove, on the south side of the Alaska Peninsula, a few miles east of Thin Point, and in the fall purchased the saltery. The cannery was operated in 1911 and each year since.

In 1917 the Pacific American Fisheries built and operated a new cannery at Ikatan, on Isanotski Strait, at the eastern end of Unimak Island. The Sockeye Salmon Co. built and operated in the same year a new cannery on Morzhovia Bay, a few miles from the strait, and on the Alaska Peninsula. In 1920 the latter was moved to the Unimak Island side of the strait.

SHUMAGIN AND SANNAK ISLANDS.

Small salteries have been operated at different places on the Shumagin and Sannak groups. The plants have usually been rude and primitive affairs and were operated whenever the price of salted salmon was high enough to justify same. As the ownership, and the location in many instances changed frequently, no attempt has been made even to list them.

In 1920 the Shumagin Packing Co. installed the necessary machinery in its saltery and put up a pack of canned salmon.

BERING SEA.

Bristol Bay.—The great redfish producing section of the world is in the Bristol Bay portion of Bering Sea. This bay lies in the eastern section of Bering Sea, inside of a line drawn from Port Moller to Cape Newenham, and a number of important rivers debouch into it, in all of which the annual runs of salmon, especially reds, are important.

Bristol Bay is considerably off the line of steamship travel, and as a result the companies operating here are compelled to have ships in which to bring up their employees and supplies in the spring and to take back the men and prepared products in the late summer or early fall when the season has ended.

Cannery ships belonging to the Nushagak plants are taken into the bay and anchored as near the canneries as possible. Owing to shoals this can not be done on Kvichak Bay and the Naknek and Ugaguk Rivers. In the early days of the fisheries the ships running to the latter canneries were brought as close to the plants as possible, unloaded by means of scows, and then taken to the Nushagak for shelter. When their numbers were too great to permit of this they were moored in the open about 5 miles off the point separating Kvichak Bay and Naknek River, where the anchorage is good and the vessels have very little trouble in riding out storms. Usually the captain and a boy are left aboard the ship.

NUSHAGAK RIVER AND BAY.

The Nushagak River, sometimes called the Tahlekuk, with its tributaries, and the Wood River, which enters the head of Nushagak Bay close by the mouth of the Nushagak, form a favorite resort of the red salmon, while all other species also ascend them.

But little is known of the upper courses of the Nushagak River, except that they drain the region between Lakes Clark and Iliamna on the east and the Kuskokwim on the west.

The river is said to be 200 miles long to the first lake, a large one. Beyond this lake there are three other smaller lakes, all connected by short stretches of river. The largest tributary of the river is the Malchatna, which enters it about 100 miles from the mouth. There are also several small tributaries, two of these being Tikchik River and Portage Creek. There are three or four Indian villages on the Nushagak, Kaknak being the largest. A launch drawing 3 to 3½ feet of water can navigate about 120 miles from the mouth. It is necessary to use a "bidarka" to go into the upper reaches. There are four rapids, around which a portage must be made in each case.

The river on its lower course is large, and flows a great quantity of water into the head of Nushagak Bay.

Wood River is about 24 miles long from its mouth to the first lake. Shoals and bars are frequent in the river, the depth on these at low water being 2½ feet and at high water 4 feet.

Aleknagik Lake, the first of the chain of three, is about 24 miles long, and has an average width of about 2 miles.

Wood River is noted especially for the interesting counting experiment the Bureau of Fisheries is carrying on here. This very important work was first taken up in 1908, as an indirect result of the order closing Wood and Nushagak Rivers to the commercial fisher-

men, as noted below, and has been continued, with the exception of 1914, to the present time. This work is made possible by the generosity of the Alaska Packers Association of San Francisco and the Alaska-Portland Packers Association of Portland, Oreg., who furnish the material and erect the barricade, also the labor needed throughout the season, while the Bureau of Fisheries furnishes the personnel required to carry on the direct work of counting the fish and making other observations.

A rack or trap is constructed across the foot of Lake Aleknagik, at a constriction in the lake contour something more than 200 yards wide, for the purpose of intercepting all salmon entering the lake and passing them through gates or tunnels at such a rate and in such a manner that an accurate estimate of their numbers can be obtained. The pot of the trap is located near the left bank, and this has three gates by which the salmon can be passed from the pot into the lake. Each gate is 2 feet in width, and its bottom rests on a wooden platform covered with white oilcloth, so that the fish can readily be seen as they pass over it when the gate is raised. When fish are passing through a gate a small wooden frame with a glass center is arranged so it will float on the water, and in order to hold it in position it is fastened to the framework of the gate. This is for the purpose of making the water smooth so the fish can readily be seen even though the surface be disturbed by ripples, etc.

When the fish are coming rather slowly, every one is counted by means of a tally register as it passes out through the gates. When the large run comes the following method is employed: An actual tally of every salmon passing through is made for one minute, and this is repeated 15 minutes later, the number passing through for 1 minute being regarded as the average for 15 minutes. A sheet with the whole day divided into quarter hours is kept ready at the gate and the number for one minute as taken from the tally register is immediately entered thereon by the attendant who made the tally. From these figures the total for the day is obtained. During only a small part of the season has it been found necessary to resort to this method of estimating the run.

The following table shows for each year since 1908 the commercial catch of salmon made in Nushagak Bay, the number of fish passing from Wood River into Lake Aleknagik, the total of both and the percentage of salmon that escaped the fishermen:

| Year. | Nushagak Bay catch. | Wood River tally. | Total. | Per cent of escape. |
|-----------|------------------------|----------------------|-----------|------------------------|
| 1908..... | 6,140,031 | 2,603,655 | 8,740,686 | 30.0 |
| 1909..... | 4,657,635 | 893,244 | 5,550,879 | 10.0 |
| 1910..... | 4,584,755 | 670,104 | 5,054,859 | 13.2 |
| 1911..... | 2,813,637 | 354,299 | 3,167,936 | 11.1 |
| 1912..... | 3,566,950 | 325,204 | 4,192,214 | 7.7 |
| 1913..... | 5,238,008 | 753,109 | 5,980,117 | 12.5 |
| 1914..... | 6,174,097 | (a) | | |
| 1915..... | 6,676,457 | 259,341 | 5,935,798 | 4.3 |
| 1916..... | 3,692,574 | 551,959 | 4,144,533 | 13.3 |
| 1917..... | 5,679,818 | 1,081,598 | 6,761,326 | 15.9 |
| 1918..... | 6,078,905 | 943,202 | 7,022,167 | 13.4 |
| 1919..... | 1,452,931 | 145,114 | 1,598,045 | 9.0 |

a Work not carried on this year.

Snake River, a tributary of Nushagak Bay, is about 30 miles in length, very crooked, and has its rise in a single lake close by Aleknagik Lake. There is an Indian village on the river just below the lake. Red salmon are abundant in this stream.

Igushik River is about 50 miles in length and enters Nushagak Bay about 4 miles above Nichols Hills. So far as known it has its source in two lakes—Amanka and Ualik. A short distance below the first lake there are rapids and a small falls. The quite large Indian village of Yacherk is located here, and the natives do most of their fishing in the rapids. Peter M. Nelson established a saltery about 10 or 12 miles above its mouth in 1902, and operated it until he sold it to the Alaska Fishermen's Packing Co., who have operated it since. There is a small Indian village close by the saltery.

Nushagak Bay, in which practically all the fishing is carried on, is about 35 miles long and from 5 to 15 miles in width. Sand bars and mud flats, which are visible at low water, occupy the greater part of its area.

The drift gill net is the favorite apparatus in this bay, although a few traps are also used. The fish begin to run very early here. Kings usually appear about June 5, reds about June 5 to 8, cohos either late in June or early in July, dog salmon about the middle of June, and humpbacks about the same time. The reds do not run in large numbers until late in June.

Considerable fishing was carried on in both the Nushagak and Wood Rivers until in 1908, when, as a result of a hearing held by the Secretary of Commerce and Labor on December 16 and 17, 1907, it was decreed that beginning January 1, 1908, "it is hereby ordered that until further notice Wood River, a tributary of Nushagak Bay, in the district of Alaska, and the region within 500 yards of the mouth of said Wood River be closed to all commercial fishing, and that all commercial fishing be prohibited in Nushagak River proper."

The earliest fishing by whites in the Bristol Bay section was for salting purposes by the trading companies, more particularly the Alaska Commercial Co., which had an important station at Fort Alexander on Nushagak Bay. Petroff, in the census report of 1880, refers to exports from this section of "from 800 to 1,200 barrels of salted salmon per annum from the Nushagak River."

In 1883 the schooner *Neptune* visited the Nushagak on a salting trip. The next year the Arctic Packing Co. erected a cannery here and made a trial pack of 400 cases. This was the first cannery to operate in Bering Sea. It was located close to the Moravian mission. This cannery eventually became a member of the Alaska Packers Association, and has not been operated for several years.

The second cannery to be built was by an Astoria company, the Alaska Packing Co., and it was erected on the western side near the head of the bay and about 1½ miles below the junction of the Wood and Nushagak Rivers. It has been operated every year to date, being since 1893 a member of the Alaska Packers Association. It is popularly known as the "Scandinavian" cannery.

In 1886 the Bristol Bay Canning Co. was organized by San Francisco parties, and built a cannery on the western shore of Nushagak Bay in a bend about 2 miles below the cannery of the Alaska Packing Co., at a place called Dillingham. It became a member of the Alaska Packers Association in 1893 and was operated each year until 1907.

A couple of years later it was dismantled. This plant was popularly known as the "Bradford" cannery.

The Nushagak Canning Co. built a cannery on the eastern shore of Nushagak Bay in 1888, at a place known as Clark Point, $5\frac{1}{2}$ miles below Fort Alexander. This cannery also became a member of the Alaska Packers Association in 1893, but from 1891 to 1901 was not operated, but held in reserve. In the last-named year a large double cannery was built here and put into operation and has been operated each year since.

This company also built and operated a saltery on the Igushik River in 1886. Three years later it was moved to the mouth of the Nushagak. In 1893 C. E. Whitney & Co. purchased an interest in it and by 1899 owned it all. In 1902 the saltery was sold to the Alaska Packers Association, which closed it down.

In 1899 the Pacific Steam Whaling Co. built a cannery and commenced canning on the eastern shore of Nushagak Bay at Fort Alexander, or Nushagak village. This cannery was purchased by the Pacific Packing & Navigation Co. in 1901, and upon the sale of its properties in 1904 became a part of the Northwestern Fisheries Co. It has been operated each year since the latter company acquired it.

The same year the Alaska Fishermen's Packing Co., of Astoria, built a cannery immediately below that of the Pacific Steam Whaling Co., and operated it every year to date, control of the company passing to Libby, McNeill & Libby in 1913.

In 1901 the Columbia River Packers Association, the Alaska-Portland Packers Association, and the Alaska Salmon Co. all built canneries on the Nushagak and have operated them to date, except the last named in 1909, when its supply ship was wrecked. The Alaska Fishermen's Packing Co. also built a saltery here. The latter plant was abandoned in 1904.

In 1903 the North Alaska Salmon Co. operated a new cannery on the Nushagak, a few miles below Clark Point.

In 1910, on August 10, shortly after the packing season had ended, the plant of the Alaska-Portland Packers Association was completely destroyed by fire. The plant was rebuilt in time to operate the next season.

KVICHAK RIVER AND BAY.

The Kvichak River is about 80 miles in length, varies from 100 yards to a mile in width, and discharges a vast quantity of water. The influence of the tide is felt 30 miles from the mouth. The current is very swift, running in places as much as 7 miles an hour. The upper half of the river is filled with low, grassy islands, the channels in many places being quite narrow. A launch drawing 3 feet of water can reach Lake Iliamna with very little difficulty. In most sections there are over 2 fathoms of water in the channels. The river drains Iliamna Lake, the largest lake in Alaska, which is about 90 miles long and about 30 miles wide, and Lake Clark. There are a number of Indian villages along the shores of the river and lakes.

Practically all of the fishing here is carried on in Kvichak Bay, gill nets being the only form of apparatus in use. As it is not convenient for the fishermen to take the catch to the canneries, large house lighters and scows are moored in convenient places and the fishermen live aboard the former, while the fish are put aboard the

latter and taken to the canneries by the run boats. The numerous shoals in the bay seriously impede both fishing and navigation.

The first fishing operations on the Kvichak were in 1894, when the Prosper Fishing & Trading Co. and the Alaska Packers Association each established a saltery and operated that year and in 1895; in 1896 the latter purchased the plant of the former and consolidated the two.

In 1895 the Point Roberts Packing Co., which was owned by the Alaska Packers Association, built a cannery at Koggiung, the site of the former saltery, and operated it the next year.

In 1900 there was a considerable development in this region. The Kvichak Packing Co., owned by the Alaska Packers Association, built a cannery on the northern point of entrance to Bear Slough, while the North Alaska Salmon Co. built two canneries about 1,000 feet apart on the left bank of the Kvichak, about 6 miles above Koggiung.

The latter company built a cannery at Hallerville on the Lockenuck River, a tributary of the Kvichak, in 1904. In 1913 a large new cannery to take the place of the Hallerville plant was built on the lower side of Pedersen Point, lower down on Kvichak Bay. In 1916 all the plants of this company were purchased by Libby, McNeill & Libby and have been operated by that company since.

The second plant of the Alaska Packers Association, known as the Coffee Creek plant, was burned down in 1906. It was rebuilt in 1908 and operated again in 1909, and has been operated continuously ever since.

In 1904 the Union Packing Co. established a cannery on the left bank a little distance above the canneries of the North Alaska Salmon Co., having moved this plant from its original location on Kell Bay, in southeast Alaska. It was operated until 1907, when it was abandoned.

About 1905 the Northwestern Packing Co. built a saltery on the east side of the bay. In 1908 it was sold to and operated by Nelson, Olsen & Co., who in 1910 sold it to the Alaska Fishermen's Packing Co., which the following year turned it into a cannery. In 1913 Libby, McNeill & Libby bought this and the Nushagak plant, and continued to operate them under the old name. This cannery was destroyed by fire in the spring of 1915. It was rebuilt and operated in 1916.

NAKNEK RIVER.

But little is known of the Naknek River for more than 10 or 15 miles from its mouth. It is said that the river is about 60 miles long, and has its rise in a lake which is of considerable size. With the exception of a short series of rapids, up which it is possible to haul a boat with a rope from the shore, the river is navigable for small craft. Shoals and banks, many of which uncover at low water, are abundant in the lower courses of the river.

Red salmon is the principal species entering this river, although all the other species are to be found here in lesser abundance. They appear here a little later than in the Nushagak Bay. Only gill nets are used in fishing.

The first commercial fishing on the Naknek River was in 1890, when the Arctic Packing Co. built and operated a saltery on the east bank about 4 miles from the mouth. This plant was sold to the Alaska

Packers Association in 1893. The next year the latter built a cannery here, made the first pack in 1895, and has operated the cannery every year since. Ultimately the saltery was merged with the cannery.

In 1901 the association built another cannery about a mile nearer the mouth, and in 1911 still another was built close to the mouth.

In 1890 L. A. Pedersen built and operated a small saltery on the right bank about 3 miles from the mouth. In 1894 the Naknek Packing Co. purchased the saltery and erected a cannery a short distance above. This saltery and another built on the shore of Kvichak Bay in 1897 were operated for some years. In 1907 the latter was turned into a cannery and operated by Mr. Pedersen under the name of the Bristol Bay Packing Co. The Naknek Packing Co. cannery has been operated to date.

In 1916 the Red Salmon Canning Co. built and operated a cannery on the river about 2 miles above the plant of the Naknek Packing Co.

In 1918 the Northwestern Fisheries Co. operated a new cannery on the river about 2 miles below the plant of the Naknek Packing Co.

In 1919 the Alaska-Portland Packers Association operated a new cannery on the river several miles above the upper cannery of the Alaska Packers Association.

UGAGUK RIVER.

According to the natives this river, which is frequently called the Egegak, or Igagik, is about 80 miles long from the mouth to Lake Becharof, at the head. The lake itself is about 45 miles long and 15 miles wide. The river is navigable for small boats to within 10 miles of the lake, whence there is a succession of rapids, around which it is necessary to portage. The lower part of the river has numerous shoals, some of which are exposed at low water. King Salmon River, the principal tributary, enters about 7½ miles from the mouth.

The red salmon is the principal species, although all the other species are found in much lesser abundance. Gill nets alone are used here.

In 1895 the Alaska Packers Association established a fishing station on the right bank about 5 miles from the mouth and operated as a saltery until 1900, when the apparatus was moved to the cannery site.

In 1899 the Alaska Packers Association, under the name of the Egegak Packing Co., commenced building a cannery on the left bank opposite and a little above the salting station. This plant was finished in 1900 and packs were made that year and each succeeding year except 1905 and 1906.

In 1903 the North Alaska Salmon Co. built and operated a cannery on the opposite shore from the Alaska Packers Association, and has operated it each year to date, of late years under the name of its new owners, Libby, McNeill & Libby.

UGASHIK RIVER.

This river has its rise in a chain of two lakes, but with the exception of that portion below the upper cannery, about 25 miles, it is very little known to the whites. The river is very tortuous in its

course. It has two known tributaries—King Salmon River, which enters through the left bank about 17 miles from the bar at the mouth, and Dog Salmon River, which enters through the left bank about 37 miles from the bar. From Smoky Point to the capes at the mouth the river widens very greatly, being about 20 miles across at the mouth. Shoals are numerous, but there is a channel with about 9 feet at low water. Gill nets exclusively are used here.

This river is essentially a red salmon stream, but the other species are also taken in small numbers, although the humpback is very scarce. This river is noted for the great falling off in the run of red salmon of recent years, 769,002 red salmon being taken in 1901, 1,640,973 in 1902, 1,703,536 in 1903, 564,492 in 1904, 432,779 in 1905, and 152,140 in 1906. About 1916 the run showed signs of improvement and during 1917 and 1918 was excellent, but the run of 1919 was small, the same as elsewhere in Bristol Bay.

C. A. Johnson was the first man to operate commercially on this river, having erected a saltery on the left bank, about 23 miles above Smoky Point, in 1889, and operated it continuously from 1889 to 1898, both inclusive. This saltery was merged in the cannery of the Bering Sea Packing Co. In 1894 Mr. Johnson established and operated another saltery on the right bank of the river, about 12 miles from the bar, which he sold in 1899 to the Alaska Packers Association, who absorbed it in their cannery plant.

The Bering Sea Packing Co., a branch of the Alaska Improvement Association, in 1890 built the first cannery on the river, this being located on the left bank near the first Johnson saltery. A small pack was first made in 1891. The plant was closed in 1892 and 1893, and as the location had proven far from suitable, it was, in 1894, moved to a point on the left bank, about 15 miles above Smoky Point, where it was operated until 1896. The next year it was sold to the Alaska Packers Association. The machinery and equipment were utilized in the latter company's cannery, and the old location abandoned.

In 1893 Charles Nelson established a saltery on the left bank of the Ugashik, immediately above the last site of the Bering Sea Packing Co. It was operated in 1893 and 1894, and then sold to the Alaska Packers Association, who closed it down.

In 1893 the Alaska Packers Association also built a saltery on the left bank of the river about a mile below the last site of the Bering Sea Packing Co. It was operated each year until 1895, when it was merged into the association's cannery.

In 1895 the Alaska Packers Association built a cannery, known as the Ugashik Fishing Station, on the right bank of the river immediately above the pilot station, which is about 12 miles from the bar. It made the first pack in 1896 and packed every year until 1907, when it was closed. In 1906 its outfit was destroyed in the San Francisco fire, and it was decided to operate it as a saltery, but the burning down of the Coffee Creek cannery of the association on the Kvichak changed the plans, and a part of the saved outfit of the latter was sent to the Ugashik and the plant operated as a cannery.

The Bristol Packing Co. built a cannery on the left bank of the river about 25 miles from Smoky Point in 1900. A pack was made the same year and the plant operated continuously until 1906, when it was shut down, and a small salting crew operated a portion of the

plant. Eventually the plant was dismantled without operating again as a cannery.

In 1901 the Alaska Packers Association built and put into operation another cannery about 15 miles up the river from the other one. In 1906 this plant was shut down and eventually it was dismantled.

In 1901 the Red Salmon Canning Co. also built and operated a cannery still farther up the river and has operated it continuously to date.

ALASKA PENINSULA, BERING SEA SIDE.

Of recent years canneries have been located on the Bering Sea side of the Alaska Peninsula, outside of Bristol Bay proper, but it is probable that their numbers will not be large in the future, as the fisheries tributary to them are not very extensive, and are also very much scattered, making transportation expensive.

Port Heiden.—This important indentation on the Bering Sea side of the Alaska Peninsula, about midway between the Ugashik River and Port Moller, has never figured to any considerable extent in fishing operations. In 1912 and 1913 Gorman & Co. had the schooner *Harriet G.* located here throughout the season, engaged in salting salmon. The Ilulik Packing Co. operated a saltery here in 1918.

Port Moller.—This great indentation in the Alaska Peninsula, between Port Heiden and Nelson Lagoon, was neglected for many years for the more profitable Bristol Bay region.

About 1902 the Bering Sea Packing & Trading Co. (there seems to be some confusion between this name and that of the Peninsular Packing Co., the latter being the name the company was known by after the first year or two in the official records), established a saltery on Bear River, which debouches a little east of Port Moller, and operated it until 1906, after which operations were suspended and but little is now left of the plant.

In 1912 the Pacific American Fisheries erected a cannery on Port Moller, but it was not operated until 1913. This concern has been successful mainly because of its introduction of purse seines in fishing.

In 1916 the Bering Sea Packing Co. built and operated a cannery on Herendeen Bay, a branch of Port Moller. In 1917 two new canneries were built and operated here, that is, the Fidalgo Island Packing Co. and the Phoenix Packing Co. In 1918 the Bering Sea Packing Co. was taken over by the Everett Packing Co. In 1919 all three Herendeen Bay canneries, as a result of the exceedingly slight runs of the two previous seasons, combined forces for the season and put up all the fish caught at the plant of the Fidalgo Island Packing Co.

Nelson Lagoon.—Nelson Lagoon is on the Bering Sea side of the Alaska Peninsula, is about 6 miles in length and about 2 miles in width. At its western end debouches the Nelson River, which is about a mile wide at its mouth. About 18 miles from the mouth the river divides, both branches having their rise in lakes. There is an easy portage from the lakes to Pavlof Bay, on the Pacific side of the peninsula, and this route is used frequently by both white men and Indians. The run is mainly of red salmon, and gill nets and traps are utilized. During the last few years purse seines have been used in this region with considerable success.

In 1902 Charles Johnson, who had operated on the Ugashik River, established a saltery here and operated it under the name of the Lagoon Salmon Co., and made a pack that and the succeeding year. In 1904 and 1905 it was shut down. It was reopened in 1906 and continued to operate until it was sold in 1914. In 1915 the new owners, the Nelson Lagoon Packing Co., built a cannery here which was operated until 1920, when it was shut down.

Unalaska Island.—In 1916 the Pacific American Fisheries, having obtained a permit from the Department of Commerce, built a cannery at Unalaska, on Unalaska Island. This cannery is located inside of the Aleutian Islands reserve, and permit was given for its building and operation so that it might be possible for the Indians of Unalaska and Dutch Harbor to obtain work at home and save them the long trip to the Bristol Bay plants. It ceased operations at the end of the 1917 season.

KUSKOKWIM RIVER.

This, one of the great rivers of Alaska, has been but little exploited as yet. Very little accurate data have been obtainable about the river until within the last couple of years, and this relates mainly to the bay and a few miles of the adjacent river, which the United States Coast and Geodetic Survey has charted.

We know that the river has considerable runs of salmon, but usually ice conditions have been such in the spring that a cannery crew frequently could not get in in time to prepare for the run. In 1906 a salting outfit was sent here by Seattle dealers, but arrived too late for the run of fish. The outfit was cached at Bethel.

During the last seven years some mild curing of king salmon has been carried on here, but the lack of cold storage, both ashore and on the vessels operating to and from the river, has prevented any considerable development of this industry.

YUKON RIVER.

The 1918 report of the Alaska agent of the United States Bureau of Fisheries ^a contains the following account of the development of the salmon fisheries of the Yukon River:

The development of the Yukon salmon fisheries began in 1918 with the establishment of a floating cannery at Andreafski. The season's operations resulted in a pack of 13,463 cases of salmon, divided as follows: Cohos 2,661, chums 6,471, humpbacks 107, and kings 4,224 cases. In addition to this, 10,400 pounds of cohos and chums were dry-salted. The total catch of salmon for the cannery was 115,531, of which 26,144 were cohos, 73,921 chums, 3,227 humpbacks, and 12,239 kings. Fishing was carried on from the mouth of the Yukon to a point above the junction of Clear River, chiefly in that part of the Yukon delta known as Kwikluak Pass. The fishing seasons were as follows: Kings, June 26 to August 17; chums, June 28 to September 8; humpbacks, July 7 to July 29; and cohos, August 3 to September 8. Some of the cannerymen and others frequently refer to salmon of one kind by the name "Yukons" or "Yukon salmon." In so doing they mean bright or fresh-run chums.

An investment of \$18,000 was made in the plant. One stern-wheeler, the *Martha Clow* (65 tons net), one gas boat, the *Althea* (17 tons net), and three smaller power boats were operated in connection with the cannery. Salmon were taken with 124 gill nets aggregating 9,869 fathoms, and 6 wheels of the two-scoop pattern. Employment was given to 169 men, 55 being fishermen, 102 shoresmen, and 12 transporters. Of these 36 were natives, 13 of whom were listed as fishermen.

^a Alaska Fisheries and Fur Industries in 1918. By Ward T. Bower. Appendix VII, Report, U. S. Commissioner of Fisheries, 1918, pp. 29-30. Washington, 1919.

Stokes & Stokes operated a small saltery on the lower Yukon, packing 15 barrels of chum salmon. Their plant was valued at \$1,500. Equipment consisted of one power boat and 300 fathoms of gill nets. They report having located too far up the river, but before another season will move to a point lower down.

Warden C. F. Townsend reported that one Sepella operated a saltery on the Yukon about 12 miles from salt water and that a pack of 110 barrels of chums and cohos was made. Salmon were taken with gill nets and one wheel. Mr. Townsend also advised that the Delta Fishing Co. was in the field in a small way.

Statistics compiled at the close of the season of 1918 indicate that exclusive of gear operated by the cannery and salteries near the mouth of the river, the whites and natives on the Yukon and tributary waters used 393 fish wheels, valued at \$19,650, and 130 gill nets aggregating 3,250 fathoms, valued at \$6,500. The estimated catch for local requirements was 1,400,000 salmon, which when dried represented approximately 700 tons of fish, valued at \$140,000.

The total population of the Yukon region of Alaska, dependent in some measure on the fisheries, was estimated late in 1918 as being 10,907, of which number 6,638 were whites and 4,269 were natives. The number of dogs in the region was estimated at 6,183.

Prior to the season of 1918 the size of the run of salmon in the Yukon was an almost unknown quantity. The belief was expressed in some quarters that a comparatively small run ascended its waters, but others who were interested in the commercial exploitation of its fisheries held the opinion that a run aggregating many millions of salmon annually ascended the river. The necessity of maintaining the fisheries is paramount at all times, and if it is reasonable to suppose that a serious depletion of the supply by unrestricted fishing seems imminent, limitations must necessarily be imposed. This was done on December 11, 1918, by the promulgation of regulations affecting commercial fishing for salmon in the Yukon River. The closing order which is published in full on page 11 in this report became effective January 1, 1919.

MISCELLANEOUS PLACES.

At times small quantities of salted salmon have been packed in Bering Sea in the neighborhood of Nome and St. Michael. In 1917 the Arctic Fish Co. operated on a large scow on Golovin Bay, near Nome.

ARCTIC OCEAN.

Although it is known that there are good runs of salmon in some of the rivers debouching into the Arctic, the ice and other conditions have deterred people from attempting to extend their operations into this region. In 1912, however, the Midnight Sun Packing Co. built and operated a small cannery on Kotzebue Sound, in the Arctic Ocean. A small pack, mostly of Dolly Varden trout, was made in that and subsequent years. The plant was not operated in 1919.

BRITISH COLUMBIA.^a

Fraser River.—This, the largest river in British Columbia (over 1,000 miles in length), has been important from a fishery standpoint ever since salmon canning was taken up commercially.

The Hudson Bay Co., the first to prepare salmon for commercial purposes, bought the fish from the Indians and pickled them in barrels for export, mainly to the Hawaiian Islands and Asia.

Howay,^b in his work on "British Columbia," after describing briefly the fishing operations carried on by the Hudson Bay Co. in the Fraser River, has the following to say with respect to the develop-

^a The author is indebted to Henry Doyle, of Vancouver, British Columbia, for practically all of the historical data relating to the canning industry of British Columbia, and hereby expresses his deep appreciation for this and many other courtesies.

^b British Columbia, from the earliest Times to the Present. By F. W. Howay. 4 vols., illus. Vancouver, 1914.

ment of the commercial salmon fisheries and the preparation of the catch by salting and canning on the part of the independents who succeeded the company:

SALMON CANNING INDUSTRY.

No sketch of our history could be called complete without containing some reference to the origin and development, during the early stages, at any rate, of the industry of salmon canning.

By its charter the Hudson Bay Co. was granted "the fishing of all sorts of fish, whales, sturgeons, and all other royal fishes in the seas, bays, inlets, and rivers, within the premises (that is within the undefined area surrounding Hudson Bay), and the fish taken therein." Though no similar grant was contained in the exclusive license of trade with the Indians west of the Rocky Mountains, which was the only title the company had in this region, yet it claimed and exercised a monopoly of the salmon fishing on the Fraser River.

Reference has already been made to the salmon fishery carried on by the company at San Juan Island. In August, 1829, at Fort Langley (the name of this place has since been changed to Derby) 7,544 salmon were obtained from the natives at a cost of £13 17s. 2d. in goods. The trade increased; in 1835 and for many years thereafter 3,000 or 4,000 barrels of salt salmon were exported, principally to the Hawaiian Islands. With the revocation of the license in 1858 this claim of monopoly fell.

Capt. William Spring, in 1863, began salting and curing salmon at Beechy Bay. In the following year Mr. Annandale, with whom Mr. Alexander Ewen was associated, opened a salmon saltery on Fraser River. This venture was almost a complete failure owing to the attempt to use the Scotch trap nets instead of drift nets. The former were found utterly unsuited to the conditions on Fraser River. When this enterprise failed, Mr. Ewen introduced drift nets and carried on an extensive business in salted salmon with the Hawaiian Islands and Australia.

The first attempt, on the Fraser River, to preserve salmon in hermetically sealed cans was made in 1867 by James Symes. This was not a commercial effort, but a mere experimental test to ascertain the possibility. A few cases were prepared, filled, and cooked by boiling on an ordinary kitchen stove. The result was most encouraging. The product was shown at the agricultural exhibition held in New Westminster in October, 1867, and was pronounced excellent, the directors making special mention of it.

About the same year Donald McLean established another salmon-curing establishment at New Westminster. Besides salted salmon, he put up pickled salmon, salmon boiled and preserved in vinegar, and smoked and kippered salmon.

The canning of salmon as a business was first undertaken on the Fraser by Alexander Loggie & Co. The persons interested were Alexander Loggie, Alexander Ewen, James Wise, and David S. Hennessy. Mr. Wise was an experienced fisherman; Messrs. Loggie and Hennessy had had experience in the canneries of New Brunswick. In June, 1870, these persons built, in connection with a salmon saltery, the first salmon cannery in British Columbia. It was located at Annieville, about 3 miles below New Westminster. The cannery was a very primitive affair; the cylinders upon which the cans were shaped were of wood covered with sheet iron; the trays were small wooden contrivances holding about three dozen one-pound cans. There was practically no machinery; the operations were almost entirely by hand. The fish after being put into the cans was preserved by boiling in large wooden vats. Great difficulty was experienced in thoroughly cooking the fish, the boiling point of ordinary water not proving sufficient; to overcome this, salt was added to the water, and by this means the temperature was raised to 230°. The room in which the cooking was performed was, in temperature like a Turkish bathroom; no windows or doors were allowed to be opened, except of necessity, under the mistaken idea that the cold currents of air would injure the product.

Capt. Stamp, who has been frequently mentioned in the foregoing pages, also entered the business at the same time. His cannery was located at Sapperton, New Westminster. He did not attempt to manufacture his cans, but obtained his supply from Mr. Deas, a tinsmith of Victoria.

About 1873, Loggie & Co. removed their cannery to New Westminster, where in the meantime Messrs. Lane, Pike, and Nelson had established themselves in the same business. These latter persons conceived the plan of canning the salmon whole; the sockeyes, being of an almost uniform size, lent themselves readily to this attempt. It was, however, a failure, as owing to the great vacuum in the cans, they became much distorted.

In 1872 Holbrook & Co. purchased a small cannery which had been started at Sapperton by Capt. Stamp some time before, and operated it for a few years.

In 1876 there were three canneries running, consisting of Holbrook & Co., Ewen & Co., and the British Columbia Canning Co. (Deas Island).

The following year this was increased by English & Co. and Finlayson & Lane, the latter quitting after one season, being succeeded in 1878 by Lane, Pike & Nelson. King & Co., the British Columbia cannery (Annieville), and the Delta cannery also commenced operations the latter year.

In 1879 Holbrook & Co., and Lane, Pike & Nelson dropped out, and Haigh & Sons (succeeded in 1884 by the Bon Accord Packing Co.) commenced operations.

King & Co. were burned out in 1880, and Adair & Co., afterwards known as the Wellington Packing Co., commenced. A year later Laidlaw & Co. commenced operations.

In 1882 the British Union Packing Co., afterwards known as the Harlock Packing Co., commenced packing salmon. The British-American cannery and J. H. Todd & Sons (Richmond cannery) also began operations.

Joseph Spratt started a floating cannery, known as "Spratt's Ark," in 1883; he retired at the end of two years. E. A. Wadhams also began operations in 1883. In 1887 the Holly cannery was built on Lulu Island opposite Deas Island. The high water of June, 1894, partially destroyed it and the site was abandoned.

No more additional plants were built until Hobson & Co. started in 1889. The Canoe Pass Canning Co. also started the same year, as did J. H. Todd & Sons with their Beaver cannery.

The Anglo British Columbia Packing Co. was formed in 1891, taking over the canneries formerly operated by the British Columbia Packing Co. (old Annieville plant), E. A. Wadhams, British-American Packing Co., Canoe Pass Canning Co., Dunan & Batchelor (Britannia cannery), and English & Co. (Phoenix cannery).

In 1892 the Terra Nova Canning Co. began operations, and the next year the Lulu Island Canning Co., Steveston Canning Co., Pacific Coast Packing Co., Canadian Pacific Packing Co., Short & Squair, and Butimar & Dawson (at Steveston) all commenced operation.

In 1894 the Gulf of Georgia Canning Co., Dinsmore Island Canning Co., Sea Island Packing Co., and the Fishermen's Packing Co. all built and began to operate canneries.

The Alliance Canning Co., Atlas Canning Co., Boutilier & Co., and the Star Canning Co. commenced operations in 1895.

There was considerable development in 1896, when the Anglo-American Canning Co., Fraser River Industrial Co., Hume & Co., Provincial Canning Co., Westham Island Packing Co., Westminster Packing Co., and the Vancouver Packing Co. all started canning.

In 1897 the Premier Canning Co., Sinclair Canning Co., Western Fisheries, Cleve Canning Co., Welsh Bros., Currie, McWilliams & Fowler, Butimar & Dawson (at Canoe Pass), Colonial Canning Co., and the Fraser Canning Co. all began operating.

The English Bay cannery was added to the list in 1898, but the Sinclair Canning Co. and Western Fisheries plants were both de-

stroyed by fire at New Westminster and not rebuilt. The plant of the Steveston Canning Co. was absorbed that year by the Federation Brand Salmon Canning Co. and the cannery renamed the "Lighthouse" cannery.

In 1899 the Greenwood Canning Co., Scottish Canadian Canning Co., St. Mungo Canning Co., Wurzburg & Co., and Acme Canning Co. all began active operations, while in 1900 the Great Northern Canning Co. was the only addition to the list. In 1909 the United Canneries (Ltd.) was formed to take over the Gulf of Georgia, English Bay, and Scottish Canadian plants, and the Canadian Canning Co. this year also absorbed the Star, Fraser, and Vancouver canneries. In 1901 the National Packing Co. built at Eagle Harbor.

Like the other canning sections, British Columbia suffered in 1901 from an oversupply of canned salmon, due to the large number of plants which had been erected and which were producing more salmon than market could be found for. At this juncture the British Columbia Packers Association was formed. It embraced 29 out of the 48 plants on the Fraser River and 12 of those situated in Northern British Columbia waters, including the following plants: Ewen & Co., Delta, Harlock, Wellington, Lulu Island, Terra Nova, Pacific Coast, Canadian Pacific, Short & Squair (Imperial cannery), Brunswick canneries at Steveston and Canoe Pass, Dinsmore Island, Sea Island, Fisherman's Packing Co., Reliance cannery, Atlas cannery, Boutilier & Co., Hume & Co., Anglo-American, Provincial, Westham Island, Westminster Packing Co., Premier, Cleve, Welsh Bros., Currie, McWilliams & Fowler, Colonial, Greenwood, Wurzburg & Co., and the Acme Canning Co. In 1914 the corporation style was changed to the British Columbia Fishing & Packing Co. (Ltd.).

In 1902 the Fraser River Industrial cannery was sold to C. S. Windsor; in 1905 this plant was sold by Mr. Windsor to Peter Birrell.

In 1905 the Burrard Canning Co., Steveston Canning Co., Butimar & Dawson, Unique cannery, and the Vancouver Fish & Canning Co. were all built and operated. The latter was burned in the middle of the season. The same year the Great Northern cannery was purchased by McPherson & Wilkinson.

In 1906 the Great West Packing Co. cannery was built at Steveston; the Nye Canning Co. operated for part of the season on False Creek in Vancouver, and the Capital City Canning Co. built a plant at Victoria. The same year the Lighthouse cannery was leased for the season by the Royal Packing Co.; while in the following year the Unique cannery was dismantled.

In 1909 the Gulf of Georgia cannery was sold to M. Desbrisay & Co.; Peter Birrell sold the Industrial cannery to the Glen Rosa Canning Co., who have since operated it; the Lighthouse cannery was leased for the season by Kildala Packing Co.; the Gosse-Millerd Packing Co. purchased the Steveston Canning Co.'s plant; while the following year the Lighthouse cannery was leased for the season by Lee Coy.

In 1912 the Lighthouse cannery was sold to C. S. Windsor and associates. The Scottish-Canadian cannery was also sold to C. S. Windsor and associates, by whom it was operated under the name of the Scottish-Canadian Canning Co. until 1914.

In 1913 the Great Northern cannery was leased for the season to the English Fisheries (Ltd.), while in the following year the Gosse-Millerd Packing Co. bought the Vancouver and Fraser canneries from the receiver of the Canadian Canning Co. The Jervis Inlet Canning Co. acquired the Lighthouse cannery the same year.

The Scottish-Canadian cannery was acquired in 1915 by the Graham Co., while the Great Northern cannery was sold to the Defiance Packing Co.

In 1916 a new cannery was built at Liverpool, South Westminster, by the Liverpool Canning Co.

In 1917 the Gosse-Millerd Packing Co. purchased the Star cannery which had been lying idle since 1913; the Booth Fisheries Co. leased the Scottish-Canadian cannery for the season. They held an option to purchase same, but did not exercise it, and the plant has since been closed down. The Cliff-Lowman Packing Co. acquired the Lighthouse cannery from the Jervis Inlet Canning Co.

In 1918 the Canadian Fishing Co. built at Vancouver, and while their plant is not on the Fraser River it is classed in that area, as its pack will be largely secured from Fraser River fish.

Early in the spring of 1919 fire destroyed the Star, Steveston, and Lighthouse canneries, none of which have been rebuilt.

Skeena River.—The first cannery to be built on the Skeena River was in 1877, when a man named Neill built one at Inverness. In 1878 the Windsor Canning Co., consisting of Henry Saunders, W. H. Dempster, and John Wilson, of Victoria, established a cannery at Aberdeen.

There were no additions until in 1883, when the Balmoral cannery the British-American, and Robert Cunningham canneries were started.

In 1889 the North Pacific was started and in 1890 the Standard. In 1891 the Anglo-British Columbia Packing Co. bought the British-American cannery and the North Pacific Canning Co. cannery. In 1892 the Claxton, and in 1895 the Carlisle, canneries were built. In 1899 the Claxton cannery was purchased by the Wallace Bros. Packing Co. The Peter Herman (afterwards the Skeena River Commercial Co.) and Turnbull canneries were built in 1900. The last named operated only four seasons.

In 1902 the British Columbia Packers Association acquired the Balmoral, Cunningham, and Standard canneries.

In 1903 the Cassiar cannery was built. The next year the Alexandria Packing Co. was started. It was later acquired by the British Columbia Packers Association, as was also the Dominion cannery, which was built in 1906.

The Carlisle cannery was sold in 1906 to the Kildala Packing Co.

In 1911 the Wallace Fisheries (Ltd.) purchased the Claxton cannery from the Wallace Bros. Packing Co., while in 1913 the Canadian Fish & Cold Storage Co. built a cannery at Tucks Inlet, where their supply of salmon is obtained from the Skeena fishermen.

In 1916 the Gosse-Millerd Packing Co. built their Sunnyside plant. In 1918 the Northern British Columbia Fisheries (Ltd.) purchased the Skeena River Commercial Co.'s plant at Port Essington, and also erected a new cannery at Port Edward.

Rivers Inlet.—The first cannery to be built and operated on Rivers Inlet was in 1881 by Shotbolt & Draney, afterwards the British

Columbia Canning Co. The Wannuck cannery was built in 1884, the Good Hope in 1895, the Brunswick in 1896, the Wadhams and the Vancouver in 1897.

There were no changes until 1902, when the British Columbia Packers Association acquired the Wadhams, Brunswick, Wannuck, and Vancouver, the two latter being dismantled and the two former enlarged correspondingly.

In 1906 the Beaver cannery was built by J. H. Todd & Sons, the Kildalla cannery by the Kildalla Packing Co., and the Strathcona cannery by Bain & Wilson, the latter afterwards being acquired by the Wallace Fisheries (Ltd.).

In 1911 the Strathcona Packing Co.'s plant was purchased by Wallace Fisheries (Ltd.). In 1917 the Provincial Canning Co. built a plant, and in 1918 the McTavish Canning Co. also built one.

Nass River.—The first cannery to be built on the Nass River was by Henry Croasdale in 1881, and it operated for four years. The Douglas Packing Co. built a cannery here in 1882 and operated it for two years. Both were then shut down owing to the fact that the locations were too far up the river for steamers to move the packs. In 1888 the plants were dismantled and removed to Nass Harbor and Mill Bay, respectively. In 1889 the Cascade Packing Co. commenced operations, but the plant was dismantled in 1893.

In 1903 the Pacific Northern cannery was built near the mouth of Observatory Inlet, and in 1905 it was purchased by John Wallace, who moved it to Arrandale. In the latter year the Port Nelson Canning & Salting Co. started. In 1908 the Mill Bay cannery was purchased by the Kincolith Packing Co. In 1911 the Arrandale and Port Nelson canneries were bought by the Anglo British Columbia Packing Co., and in the following year the Nass Harbor cannery was bought by the British Columbia Packers Association.

The Wales Island cannery, which became Canadian property under the Alaska boundary award, was in 1911 purchased by M. Desbrisay & Co., by whom it has since been continuously operated.

In 1916 the Kincolith Packing Co.'s Mill Bay plant was purchased by the Kincolith Fisheries (Ltd.), while in 1918 the Northern British Columbia Fisheries (Ltd.) purchased the Mill Bay cannery from the Kincolith Fisheries (Ltd.) and built a new plant at Kumeon. The Western Salmon Packing Co. also built a new plant at Summerville the same year.

Queen Charlotte Islands.—In 1912 the British Columbia Fisheries (Ltd.), a concern promoted by Sir George Doughty, M. P., of Grimsby, England, built a cannery at Aliford Bay, Skidegate Inlet, and operated same for two seasons. The British Columbia Fisheries (Ltd.) then went into insolvency, and the plant remained idle until 1916, when it operated under lease to the Western Salmon Packing Co. In 1917 the cannery was purchased by the Maritime Fisheries (Ltd.), the present owners.

The Wallace Fisheries (Ltd.), built at Naden Harbor in 1912, and operated that and the following seasons. The cannery was not in commission during 1914 or 1915, but ran in the years 1916 to 1918, inclusive. It was found that Masset Inlet would be a more suitable location, and in 1919 the plant removed from Naden Harbor to a new site on the shores of the Inlet.

A cannery was built at Lockeport in 1918 by the Lockeport Canning Co. The same year the Western Salmon Packing Co. (Ltd.) built a plant at Lagoon Bay.

Miscellaneous places.—A cannery was built at Metlakatla in 1882 by Rev. John Duncan for the Metlakatla Indians, fish being obtained from Skeena River. The plant was dismantled in 1886.

John Rood built the first cannery on Smiths Inlet, in Quachela Lagoon, in 1883. It was closed in 1884, and the plant moved to Wannuck, Rivers Inlet, to which place also the Smiths Inlet fish were subsequently transported for packing purposes. In 1902 the Wm. Hickey Canning Co. built a new plant on Smiths Inlet, selling same in 1912 to the Wallace Fisheries (Ltd.). The Western Packers (Ltd.) also built at Marguerite Bay in 1917.

A cannery was built at Lowe Inlet in 1890 by the Lowe Inlet Canning Co. It was sold to the British Columbia Packers Association in 1902.

In 1890 a cannery was built at Gardiner Canal by a man named Price and his associates. It ran until 1893, when it was dismantled and closed.

Robert Draney built at Namu in 1893, selling out in 1912 to the Draney Fisheries (Ltd.), who in turn sold out to the Northern British Columbia Fisheries (Ltd.) in 1918.

Robert Draney built the Kimsquit cannery in 1901, and in 1907 the Kildalla Packing Co. built the Manitou cannery. The latter is still operating, but in 1912 the Draney Fisheries (Ltd.) purchased the Kimsquit cannery, and in 1918 sold it again to the Northern British Columbia Fisheries (Ltd.).

In 1900 the Bella Coola cannery was built by John Clayton and sold by him in 1902 to the British Columbia Packers Association, who have operated it ever since. In 1917 a new cannery was built by the Tallheo Fisheries (Ltd.) and sold by them in 1918 to the Northern British Columbia Fisheries (Ltd.).

Toms, Morris & Fraser built at China Hat in 1900 and sold to the British Columbia Packers Association in 1902. The latter dismantled and closed the plant in the fall of that year.

A cannery was built at Warke Island in 1911 by John Wallaco, principally for packing Gardiner Canal fish. Plant was purchased in 1917 by the Western Packers (Ltd.), who have since operated it.

A cannery was built at Bella Bella in 1912 by the East Bella Bella Canning Co. It was sold in 1915 to the Gosse-Millerd Packing Co., who have since operated it.

The cannery built at Alert Bay in 1881 by S. A. Spencer was purchased in 1902 by the British Columbia Packers Association, who have since operated same.

Cannery was built at Clayoquot in 1895 by Earle & Magneson. It was purchased by the Clayoquot Sound Canning Co. in 1902, by whom it has since been operated.

A cannery was erected at Bute Inlet in 1890 by C. S. Windsor and George Hobson, but only operated the one season.

The West Coast Packing Co. was built and operated at Nootka Sound in 1896, but only secured 112 cases. The plant was dismantled and abandoned. In 1917 a new plant was erected by the Nootka Packing Co., who have since operated steadily.

Dawson & Buttimer built at Alberni Canal in 1903. They sold out to the Wallace Fisheries (Ltd.) in 1911, and the latter have operated steadily ever since.

Pidecock Bros. built a small cannery at Quathiaski Cove in 1904. They operated it that and the following year and then sold to T. E. Atkins in 1907. This plant was destroyed by fire in 1909, and the following year the Quathiaski Canning Co. built a new plant, which has operated steadily since.

A small cannery was built at Pender Harbor in 1906 by P. H. Alder. It operated for two seasons and was then closed down and dismantled.

J. H. Todd & Sons and the Capital City Canning Co. both built at Victoria in 1905 (the former at Esquimalt). Messrs. Todd & Son still operate, but the Capital City Canning Co. plant was closed and dismantled in 1914.

Capt. R. E. Gosse built at Knight Inlet in 1907 at Sargeants Passage, but moved the plant to Glendale Cove in 1910, and at the close of that season sold the cannery to the Anglo British Columbia Packing Co., who have since operated it.

The Wallace Fisheries (Ltd.) built a cannery at Quatsino Sound in 1911, but dismantled it in 1914.

The Golotas Fish Co. built at Shushartis Bay in 1914, and after operating for three seasons sold the plant in 1917 to the Western Packers (Ltd.), the present owners.

The Gilford Fish Co. built a cannery at Kingcombe Inlet in 1914. After operating it that season they sold to the Preston Packing Co., the present owners.

The Jervis Inlet Canning Co. built a cannery at Jervis Inlet in 1912, operating it that and the following season. In the fall of 1913 it was destroyed by fire. In 1917 the C. L. Packing Co. erected a new plant at Green Bay, Jervis Inlet.

The Nanaimo Canning Co. started at Nanaimo in 1913 and operated until 1916, in which year the plant was acquired by the Nanaimo Cannery & Packers (Ltd.).

The Quathiaski Canning Co. was built at Blind Cove in 1916; the Gulf Island Fish Co., at Lasqueti Island, in 1916; and the Sidney Canning Co., at Sidney, in 1916.

The Redonda Island Canning & Cold Storage Co. built a cannery at Redonda Island in 1917, while the Lummi Bay Packing Co. built a cannery at Nitnat in 1917.

In 1918 the Defiance Packing Co. built a cannery at Port Renfrew, while in 1919 the Gosse-Millerd Packing Co. built one at San Mateo.

SALMON FISHING IN THE HEADWATERS.

Considerable salmon fishing is carried on in the headwaters of certain of the larger rivers of the coast, of which no account appears in the data of the commercial fisheries. This is due to the fact that the fishing is usually of a desultory character, the fisheries are few in number and scattered widely, and while the catch in the aggregate is considerable it does not amount to much in any one spot.

The Columbia River is a typical example of such a stream. Commercial fishing is usually considered as ending at Celilo, about 150 miles from the mouth. As a matter of fact, salmon fishing for market

or for home use is carried on to a considerable extent along the main river and also on the Snake and the Yakima, tributaries of the Columbia. In nearly all cases hook and line and spears are used alone, but on the Snake River, near Lewiston, in Idaho, are several rather important haul-seine fisheries. Fishing is carried on at these places in the spring for steelhead trout and in the fall for chinook and silver salmon and steelhead trout. As many as 25 salmon have been taken at one time. While this may seem a small number to one habituated to the large catches farther down the river, in the aggregate it amounts to a considerable quantity.

Considerable local fishing is carried on along the various Oregon streams above the sections usually fished by commercial fishermen. Most of this is done by ranchers living along the streams, and while by far the greater part is for home consumption a small proportion is sold.

On the Yukon River and its tributaries considerable salmon fishing is prosecuted. Much of this is done by natives for the use of themselves and their dogs, but at places white fishermen operate for a portion of the year and sell their catches in near-by settlements or at the mining camps. No effort has ever been made to secure statistics of the extent of this fishery.

APPARATUS AND METHODS OF THE FISHERIES.

GILL NETS.

The gill net is the oldest and most popular form of apparatus in use in the salmon fisheries of the Pacific coast. There are two kinds, drift and set, these names clearly expressing the difference between them. Fine flax or linen twine is generally used in their manufacture, although in some places cotton twine is employed, and it has usually 12 threads and is laid slack. They are hung in the ordinary manner—to a rope with cork floats to support the upper portion of the gear, and to a line with lead sinkers attached, which keeps the net vertical in the water and all its meshes properly distended. The nets are tanned, usually several times each season.

Drift nets vary greatly in length and depth, depending upon the width of the fishing channels, the depth of water, etc. On the Sacramento River they average about 300 fathoms in length, are 45 meshes deep, and have a stretch mesh of from $7\frac{1}{2}$ to $9\frac{1}{2}$ inches. On the coastal rivers of Oregon these nets average about 125 fathoms in length, and are about 36 meshes in depth, the mesh varying with the species of salmon sought. On the Columbia River the nets average about 250 fathoms in length and have a stretch mesh for chinooks of 9 to $9\frac{1}{2}$ inches. On the Willamette River, the principal tributary of the Columbia, they average about 75 fathoms in length, with meshes of 8 and $9\frac{1}{2}$ inches. On Willapa Harbor drift gill nets run from 100 to 250 fathoms in length, are 30 meshes deep, with stretch meshes of 7 and $8\frac{1}{2}$ inches. On Grays Harbor they average 100 fathoms in length, the chinook nets run from 24 to 45 meshes in depth, with a stretch mesh of 9 inches, while the silver or coho nets are 35 meshes in depth, with a stretch mesh of 7 inches. In northern British Columbia the nets average 150 fathoms in length with a stretch mesh of $5\frac{1}{2}$ inches. In the Puget Sound region the nets

average 300 fathoms in length, with meshes suitable for the particular species sought. In Alaskan waters the nets vary greatly in length and depth, depending upon the places where fished.

Drift gill netting is prosecuted chiefly in the estuaries of the rivers in and near the channels. If the water is clear the nets are set only at night, but should the water be muddy or discolored with glacial silt, fishing can be carried on either night or day. Night fishing is most common in the States, while day fishing is most common in Alaska. When fishing in rivers, it is necessary to work in a straight stretch of water of fairly uniform depth and free from snags or sharp ledges, these being called "reaches."

In setting the net the boat puller rows slowly across the stream while the other man pays out the apparatus, to the first end of which a buoy has been attached. When about two-thirds of the gear is out, the boat is turned downstream at nearly right angles to her former course, so that the net, when set, approximates the shape of the letter L. The net is laid out at nearly right angles or diagonally to the river's course, so that it will intercept the salmon that are running in, and is usually put out about an hour before high-water slack and taken in about an hour after the turn of the tide. In Alaska the fishermen usually fish on both the high and low slack. The nets are allowed to drift for the time specified, the fishermen drifting along at one end, then the net is hauled into the boat over a wooden roller fixed in the stern, and the fish, which have become gilled in the meshes, are removed, stunned or killed by a blow on the head, and thrown into the bottom of the boat.

Set gill nets are made in the same way as drift nets, in many instances being fragments of the latter, and are usually operated in the upper reaches of the rivers. They vary in length from 10 to 100 fathoms, from 35 to 65 meshes in depth, and have the same sizes of meshes as the drift nets, the size varying, of course, with the species sought for. Sometimes these nets are staked, sometimes anchored, while occasionally only one end is tied to the shore or a stake set in the water.

On the flats off the mouth of the Stikine River, in southeast Alaska, a combination of the drift and set method is followed. A double set of stakes, about 6 feet apart, are set out from the shore for a distance of several hundred yards. An hour or two before slack water the fishermen pay out the net parallel to the line of stakes and about 50 feet from them. The tide drifts the net down until it is caught against the stakes, which retain it until slack water, when the fisherman takes it up and repeats from the opposite direction on the next turn of the tide.

HAUL SEINES.

On the Columbia River, where this form of apparatus plays a prominent part in the fisheries, the nets vary in length from 100 to 400 fathoms; the shallowest end is from 35 to 40 meshes deep, but it rapidly increases in width and is from 120 to 140 meshes deep at the other wing. The "bunt," or bag, in the central part of the net is about 50 fathoms long. These nets are usually hauled on the numerous sand bars which are a very noticeable feature of the river at low tide. Buildings are erected on piles on these sand flats, in which the



FIG. 8.—COLUMBIA RIVER POWER GILL NET BOAT.



FIG. 9.—REMOVING THE SALMON FROM A GILL NET.

U. S. B. F. — Doc. 902.

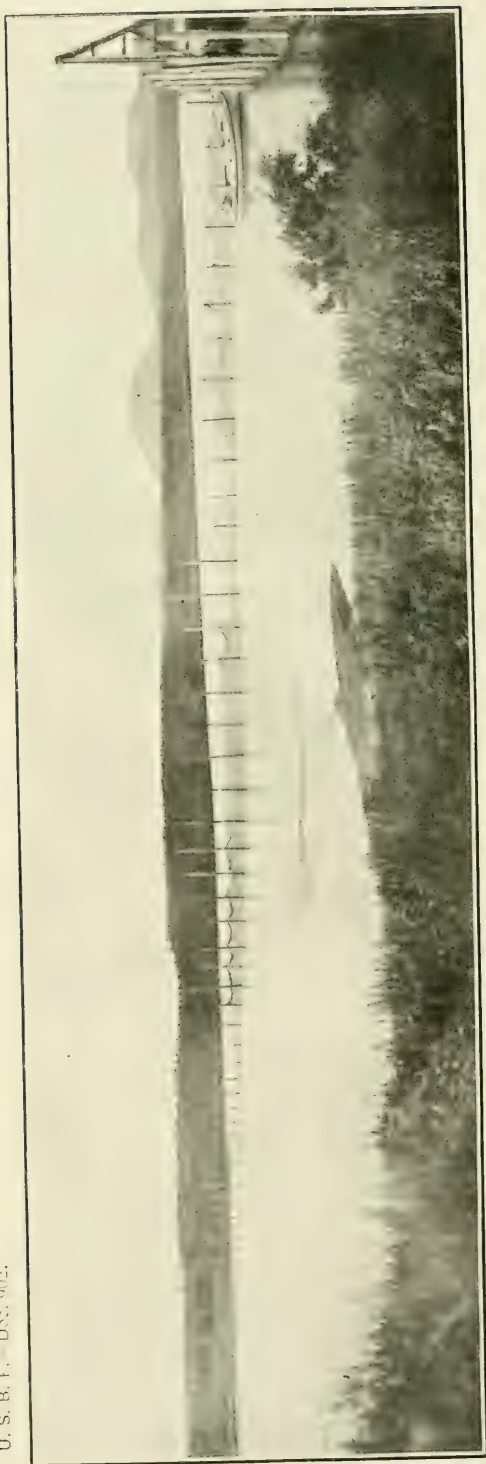


FIG. 10.—SALMON RACK ACROSS WOOD RIVER, ALASKA.



FIG. 11.—DIPPING SALMON FROM THE COPPER RIVER, ALASKA.

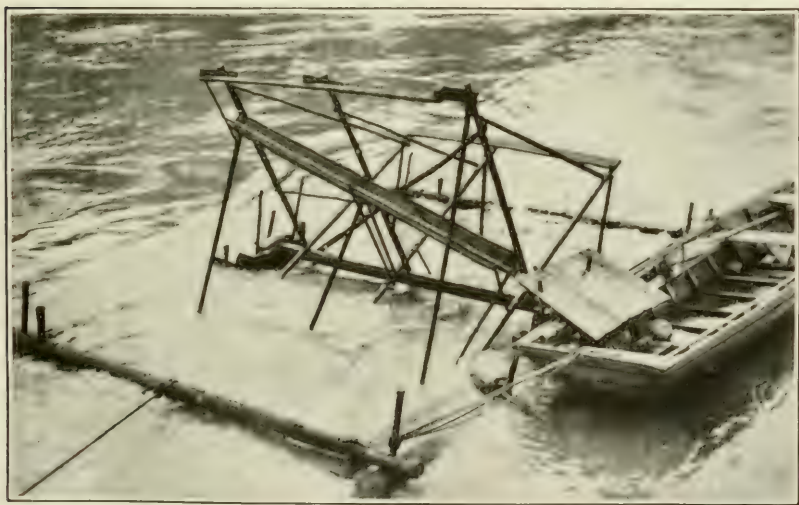


FIG. 12.—FISH WHEEL, YUKON RIVER, ALASKA.

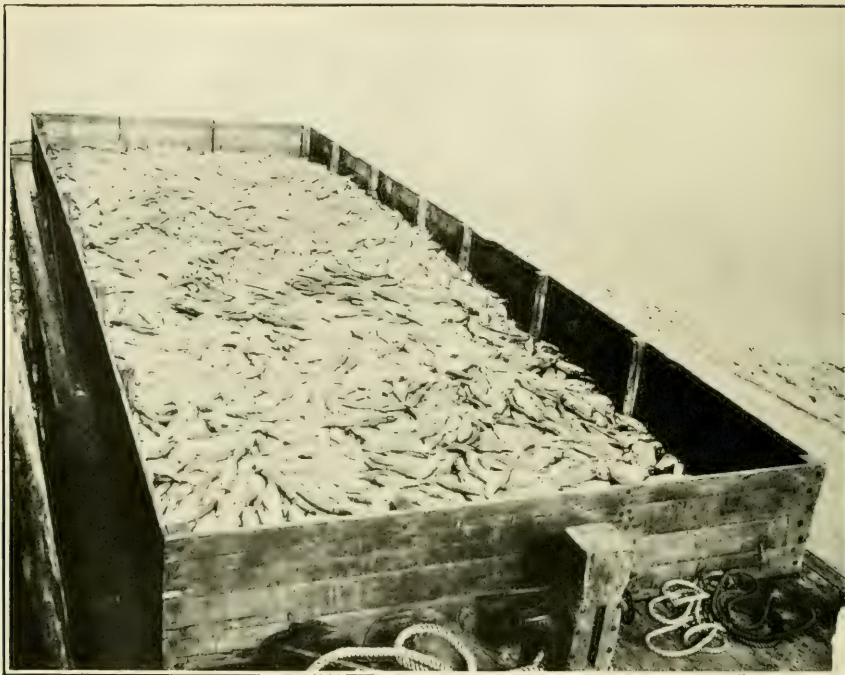


FIG. 13.—A SCOW LOAD OF SALMON.



FIG. 14.—PURSE SEINE CREW DELIVERING FISH TO CANNERY TENDER.

men and horses take refuge at high tide, when the bars are covered with water. Operations begin as soon as the beach or bar uncovers, so that the men can wade about. The net is placed in a large seine boat, with the shore end attached to a dory. At the signal the seine boat is headed offshore, while the dory heads toward the bar. As the seine boat circles around against the current the net is paid out in the shape of a semicircle. The dory men hurry to the bar with the shore end of the net, the idea being to get that in as soon as possible in order to prevent the escape of the salmon in that direction. As soon as this has been accomplished, the outer shore line is brought to the bar, when several horses are latched to the line and begin to haul in the net, care being taken by the men to work it against the current as much as practicable, and to get it in as speedily as they can in order to prevent the escape of salmon either by jumping over the cork line or finding some outlet below the footrope or lead line.

The only other place on the coast where haul seines are important is at Karluk, on Kodiak Island, in Alaska. Here the seines are hauled upon the narrow gravel spit dividing the lagoon from the strait, and practically the same method is followed as in the Columbia River.

DIVER NETS.

These are in use in the Columbia River, mainly throughout the middle and upper portions of the river. They vary from 100 to 200 fathoms in length and are used almost exclusively for chinook salmon. In construction they somewhat resemble a trammel net. Two nets are attached together side by side. The outer one, or the one toward the oncoming fish, has a larger mesh than the other, so that if the fish manages to pass through the first, it will be caught in the smaller meshes of the second.

DIP NETS.

These consist of an iron hoop secured to the end of a stout pole with a bag-shaped net fastened to the hoop. They are generally used at the cascades on the rivers, small platforms being erected upon which the operator stands while fishing. Indians formerly used them to a large extent, but, owing to the steady decline in the number of Indians, and the appropriation of favorable spots by the whites for other forms of apparatus, they are but little used now.

SQUAW NETS.

This type is virtually a set net. It consists of an oblong sheet of gill netting, about 12 feet long and 8 feet deep, its lower edge weighted to keep it down, and its upper edge attached to a pole that floats at the surface, and is held by a line or lines to another projecting pole which is securely fastened to the shore, so that it will not swing around with the strain of the swift current on the net. A single block is attached to the pole, and through this passes a rope, thus making a tackle for the more convenient manipulation of the net. The dip-net fishermen of the Columbia River use this net, which derives its name from the fact that it used to be commonly operated by Indian squaws for taking salmon. But few are now in use, for the same reasons as given for the decline in the use of dip nets.

PURSE SEINES.

This form of apparatus is in quite general use in Puget Sound and southeast Alaska, and has proved highly effective in these deep, swift waters. These seines are about 200 fathoms long, 25 fathoms in the bunt, and 20 fathoms in the wings, all with a $3\frac{1}{4}$ -inch stretch mesh. The foot line is heavily leaded and the bridles are about 10 feet long. The purse line is made of $1\frac{1}{2}$ -inch hemp. The rings through which the purse line is rove measure about 5 inches in diameter and are made of galvanized iron.

Purse seining for salmon in Puget Sound and waters north of same is one of the most important methods in use in the fisheries. In the type of vessel used in this fishery there has probably been greater improvement than in any other branch of the fisheries of the coast. In the early days row scows were in use, but now vessels with power are used.

In 1903 the first gasoline-powered purse seine boat appeared on the Pacific coast salmon fishing grounds in Puget Sound. The vessel was named the *Pioneer* and she was equipped with a 5-horsepower engine. The first season she easily demonstrated her vast superiority over the other purse seiners in the quickness with which she could reach a school of fish after it was sighted and in surrounding it with her seine. The next year there were a few more built or equipped, and the number has steadily increased until at the present time practically all except a few in southeast Alaska are equipped with motor engines.

The first power seine boats were only about 30 feet in length and had small power. As they were few in numbers, there was virtually no competition, and high power and speed were not a necessity. As the boats increased in numbers, however, competition became keener, and the first types of boats with their small power were quickly thrown into the shade by the newer types, which averaged between 45 and 55 feet in length, with 45 to 75 horsepower engines.

When motive power was introduced in the vessels, it was natural that the fishermen should soon introduce winches for the purpose of hauling in the nets, as the whole work could then be done by the one engine.

The purse seine vessels are built with rounded sterns. On an elevated section of the stern is set a movable platform on a pivot. The after end of this platform has a long roller. The purse seine is stowed on this platform, the head rope with corks on one side and the foot line on the other, so that there will be no tangling when the seine is paid out.

When the lookout sights a school of fish, the seiner is run down close to it and a rowboat launched. One man takes his place in this with the rope from one end of the seine and acts as a pivot, while the seiner circles around the school, the crew paying out the seine as she moves along. When it is all out, the vessel runs alongside the rowboat and takes aboard the other rope. Attaching this and the rope from the other end to the power winch, the circle around the fish is rapidly narrowed, and the slack of the seine as it comes in is stowed back on the platform. Around the bottom of the seine and through galvanized-iron rings about 5 inches in diameter runs the purse line. As this is hauled into the boat, the open space at

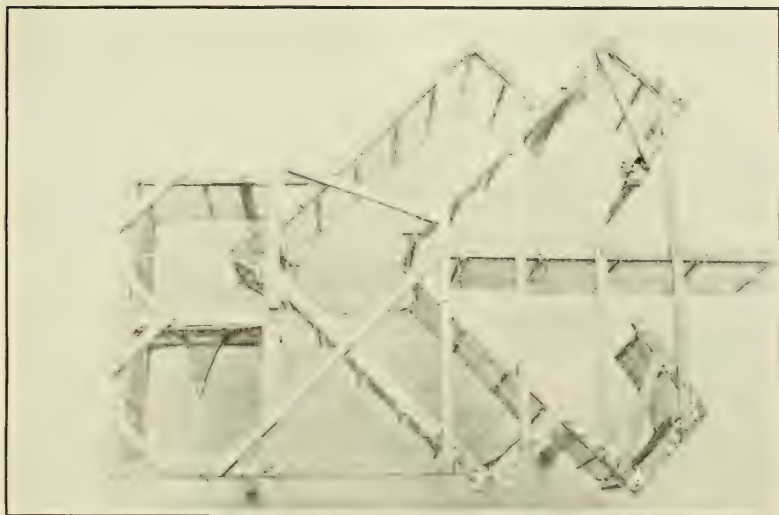


FIG. 15.—FLOATING TRAP.



FIG. 16.—PURSE SEINER HAULING IN NET.



FIG. 17.—DIPPING SALMON FROM A PURSE SEINE.



FIG. 18.—BRAILING SALMON FROM A TRAP.

the bottom is rapidly closed up just as a handbag would be through the drawing together of the pursing string at the top. During this operation the nonpower purse seiners have a man standing alongside the rail who throws a pole into the center in order to drive the fish away from the open section. He is so skillful in this work that almost invariably the pole comes back to his hand as the pressure of the waters forces it up again. When the bottom has been pursed up the fishermen hauling by hand can move more leisurely, but with the power winches in use the hauling in of the net is a comparatively easy matter, and the pole thrower is dispensed with.

When all the fish are in the bunt and the latter alongside, the fish are generally dipped out by means of a dip net balanced on the end of a tackle. A fisherman lowers it into the seine, scoops up a load of salmon, and as the net is hauled up guides it over the vessel, and then trips it and dumps the fish into the hold.

The Puget Sound purse seiners meet the salmon off the entrance to the Strait of San Juan de Fuca and follow the sockeyes till they have passed out of American waters, what are known as the Salmon Banks, off the lower end of San Juan Island, being the principal rendezvous during the run of sockeyes. After this run is over they go up the Sound and fish for dogs and cohos, and later go to the head of the Sound and fish for dogs, cohos, chinooks, and steel-head trout. In southeast Alaska they follow the fish all over the bays, straits, and sounds of that section. Purse seines are used in a few other places, but the fishery is secondary to those with other forms of apparatus.

This style of fishing is said to have been introduced on Puget Sound by the Chinese in 1886.

TRAPS OR POUND NETS.

A trap is stationary and consists of webbing, or part webbing and part wire netting, held in place and position by driven piles. This piling usually is held together above water by a continuous line of wood stringers, also used to fasten webbing to or to walk on if necessary.

In building, the "lead" is first constructed. This runs at right angles, or very nearly so, to the shore, and consists of a straight line of stakes, to which wire or net webbing is hung from top of high water, or a little higher, to the bottom, making a straight, solid wall.

At a little distance inshore of the outer end of the lead begin what are called the "hearts." These are V-shaped and turned toward the lead, beginning at a distance of 30 to 40 feet on either side of same and running in the same general direction, the "big heart" or outer heart first, the inner heart, supplementing the first, being smaller, and the end of the outer heart leading into it. Some traps have only one heart. The narrow end of the inner heart leads into the "pot" and forms what is known as the "tunnel." The tunnel ends in a long and narrow opening, running up and down the long way, and is held in position by ropes and rods. Below this is what is known as the "apron," a sheet of web stretched from the bottom of the heart upward to the pot, in order to lead the fish into the tunnel when swimming low in the water, and to obviate the necessity of

building the pot clear to the bottom, which would be expensive, as the pots of the traps are usually in quite deep water. If the trap is intended to catch the fish coming from only one direction, the lead generally runs to and is attached to one side of the entrance to the outer heart on the side opposite to that from which the fish are expected.

Some traps have "jiggers" (a hook-shaped extension of the outer heart) on each side, and sometimes on only one side, which help to turn the fish in the required direction.

The "pot" is built out beyond the inner heart and immediately adjoining same. It is a square compartment, with web walls and bottom connected in the shape of a large square sack, fastened to piling on all sides. This pot is hauled up and down by means of ropes and tackles, either by hand or, as is most popular, by steam.

The "spiller" is another square compartment adjoining either end of the pot (sometimes there are two spillers, one at each end), and is simply a container for fish. A small tunnel leads the fish from the pot into the spiller, whence the fishermen lift them out. This is accomplished by closing the tunnel from the pot, after which the ropes holding the front of the spiller are loosened and the net wall allowed to drop almost to the level of the water. A steam or gasoline tug then pushes a scow alongside the spiller and takes position on the outside of this scow. From the deck of the tug a derrick is rigged with a running line from the steam capstan through the block at the top of the derrick. This line is attached to the far end of a net apron, called a "brailer," which is heavily weighted by having chains along each side and leaded crossways at several places. A small boat is run inside the spiller, and the men in this draw the brailer across the barge and let it sink in the spiller. The fish soon gather over it, when the steam capstan quickly reels it in, the net folding over as drawn in from its far side and spilling the fish out on the scow. Men on the scow pick out and throw overboard the undesirable fish. The apron is then drawn back across the pot and the operation repeated so long as any fish remain. In this manner a trap with many tons of salmon in it is quickly emptied.

Traps, like nearly all other fixed fishing appliances, are built on the theory that salmon, like most other fishes, have a tendency to follow a given course in the water, whether a natural shore line or an artificial obstruction resembling one; also that the fish very seldom turns in its own wake. The trap has taken advantage of these natural tendencies of the fish, and is arranged so that, although the salmon may turn, he will continually be led by the wall of net toward and into the trap.

If a trap is located in a place where fish play and where an eddy exists, and the fish run one way with the incoming tide and the opposite with the outgoing, it will fish from both directions; if located where the fish simply pass by, as for instance, on a point or reef, it will fish from one side only.

A variation of the trap, to be used in places where piles can not be driven, is the floating trap. An experimental trap of this variety was used at Uganuk, on Kodiak Island, Alaska, as early as 1896. Its use was abandoned in 1897, not to be resumed until some years later. A number of floating traps (of the type invented by J. R. Heckman, of Ketchikan, Alaska) have been and are being used in



FIG. 19.—RACKS AND RUNWAYS FROM WHICH INDIANS GAFF SALMON, CHILKOOT RIVER, ALASKA.

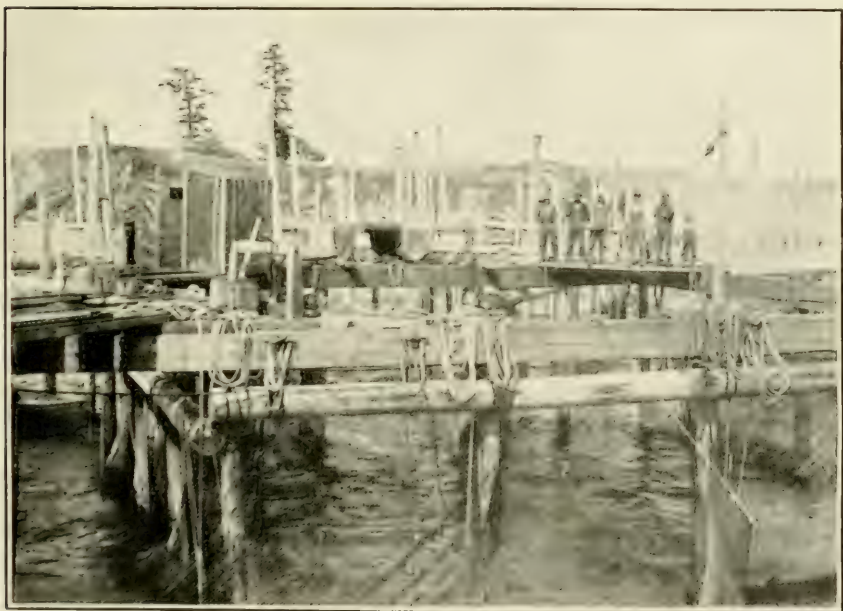


FIG. 20.—THE POT AND SPILLER OF A SALMON TRAP.



FIG. 21.—TROLLING FOR SALMON ON PUGET SOUND WITH POWER BOATS.



FIG. 22.—PUGET SOUND PURSE SEINE BOATS AT RICHARDSON, WASH.

southeast Alaska, the first having been installed in 1907. The design of this trap follows the shape of an ordinary Puget Sound driven trap. It is constructed of logs, 20 to 26 inches at the butt, bolted and braced together in one solid frame. Suspended from this frame through the logs are 2½-inch pipes extending down in the water 30 feet. Halfway down these pipes and also on the extreme lower ends are eyebolts, to which the web is drawn down and fastened. Thus the web is kept in place as well as if the pipes were driven piles. The lead is also a continuation of large piles or logs bolted firmly together with similarly suspended pipes and webbing.

The so-called wooden traps on the Columbia River are essentially weirs, being a modification of the brush weirs or traps used by the Indians for the capture of salmon long before the advent of the white men. They are built on shore, of piling and planks, the latter arranged like slats with spaces between. The bowl, or pot, is provided with a movable trapdoor that can be opened during the closed season and on Sundays, so that the fish can pass through and run upstream. These weirs, after being built, are launched into the river, placed in proper position near the shore, and then ballasted so that they sink to the bottom.

According to Collins,^a "pound nets were introduced on the Columbia River in 1879. In May of that year O. P. Graham, formerly of Green Bay, Wis., built a pound net on the river similar to those used on the Great Lakes. The success of this venture led to the employment of more apparatus of this kind, and many fishermen went West to participate in the fishery."

The first trap on Puget Sound, it is said, was built by John Waller, about 1880, off Cannery Point, at the southeastern corner of Point Roberts.

According to Collins,^b H. B. Kirby, who had previously fished on the Great Lakes, set a pound net in Puget Sound about 1883, but it was a complete failure. This was set off Point Roberts, near where the Waller trap was set. On March 15, 1888, he again set a pound net, which he had designed to meet the new conditions, at Birch Bay Head, in the Gulf of Georgia. It proved a complete success, and was the forerunner of the present large number which are set annually in these waters.

In Alaska the first trap was set in Cook Inlet about 1885. British Columbia refused to permit the use of pound nets in its waters until 1904, when their use was allowed within certain limited regions.

Some of these traps, especially on Puget Sound, have proved extremely valuable. The years 1898 and 1899 covered practically the high-water mark, as several desirable locations changed hands in those years at prices ranging from \$20,000 to \$90,000 for single traps, the original expense of which did not exceed \$5,000. But few have brought such high prices since, however, owing to the decline in the run of salmon, and at the present time but few of them would fetch much at a sale.

The location of sites for these nets is regulated by law in Oregon, Washington, and British Columbia, but in Alaska the procedure is

^a Report on the Fisheries of the Pacific Coast of the United States. By J. W. Collins. Report, U. S. Commissioner of Fish and Fisheries, 1888-89, p. 210. Washington, 1892.

^b Collins: *Op. cit.*, p. 257.

not well defined and has proved rather confusing to strangers. Some acquire the shore line by mineral location or by the use of scrip, while still others have merely a squatter's right.

Under the existing fish-trap laws applicable to Alaska, a fish trap may be operated anywhere along the coast of Alaska, 300 yards from the mouth of any salmon stream, and along the shore of all rivers—excepting those emptying into Cook Inlet, the streams on Afognak Island, and in Wood River—where the same are at least 500 feet wide.

A clear water distance of 600 yards laterally and 100 yards end-wise must be maintained between all traps. At the present time there is no law regulating the length of leads, the maximum depth of water in which the pot may be driven, or the use or occupancy of the trap sites.

It has been decided by the highest courts within the past year that title to the upland conveys no title to the trap owner who may be in front. The tidelands of Alaska are not of sufficient commercial importance as yet to enter into this controversy. At the present time there is no tideland law applicable to Alaska affecting the upland owners or the trap-site locators.

At the present time the canner who is on the ground first with piles and a driver can assert his right to any unoccupied trap site regardless of who fished it the previous season. This, however, is the exception rather than the rule. As a general proposition the canners respect the rights of rivals in the same fishing region, and a trap location once recognized as that of a certain individual or company is rarely jumped so long as the original locator cares to maintain a trap on it.

Within the bounds of the forest reserve no land can be acquired except by lease, which may be secured from the United States forestry agent, Ketchikan, Alaska.

INDIAN TRAPS.

The natives, especially in Alaska, have various ingenious methods of catching salmon. In the Bering Sea rivers they catch them by means of wickerwork traps, made somewhat after the general style of a fyke net. These are composed of a series of cylindrical and conical baskets, fitting into each other, with a small opening in the end connecting one with the other and the series terminating in a tube with a removable bottom, through which the captive fish are extracted. Some of the baskets are from 15 to 25 feet in length and are secured with stakes driven into the river bottom, while the leader, composed of square sections of wickerwork, is held in place by stakes.

During the summer of 1910 the author found and destroyed an ingenious native trap set in Tamgas stream, Annette Island, south-east Alaska. This stream is a short and narrow one, draining a lake, about midway of which are a succession of cascades. In the narrowest part of the latter, and in the part up which the fish swim, a rack had been constructed of poles driven into the bottom and covered with wire netting, so as almost wholly to prevent salmon from passing up. Just below, and running parallel to the rack and at right angles to the shore, was placed a box flume with a flaring mouth at the outer end. At the shore end the flume turned sharply

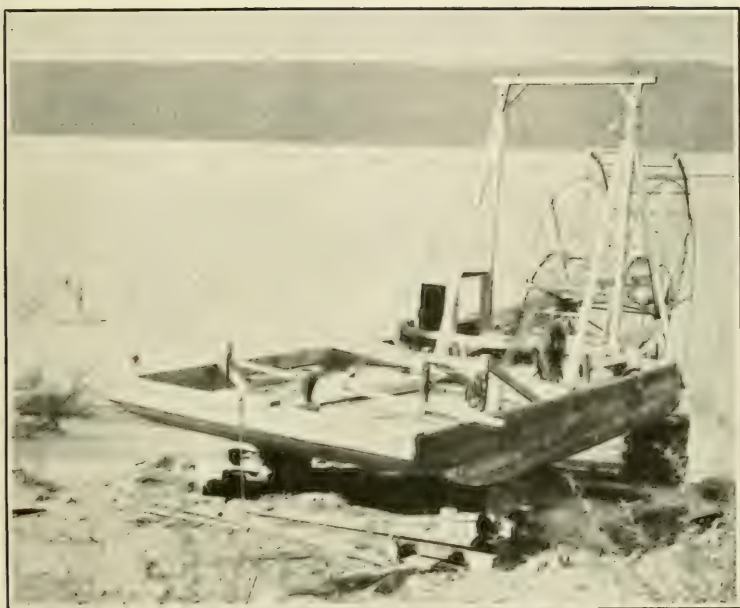


FIG. 23.—A COLUMBIA RIVER SCOW FISH WHEEL.



FIG. 24.—PUGET SOUND SALMON TRAP.

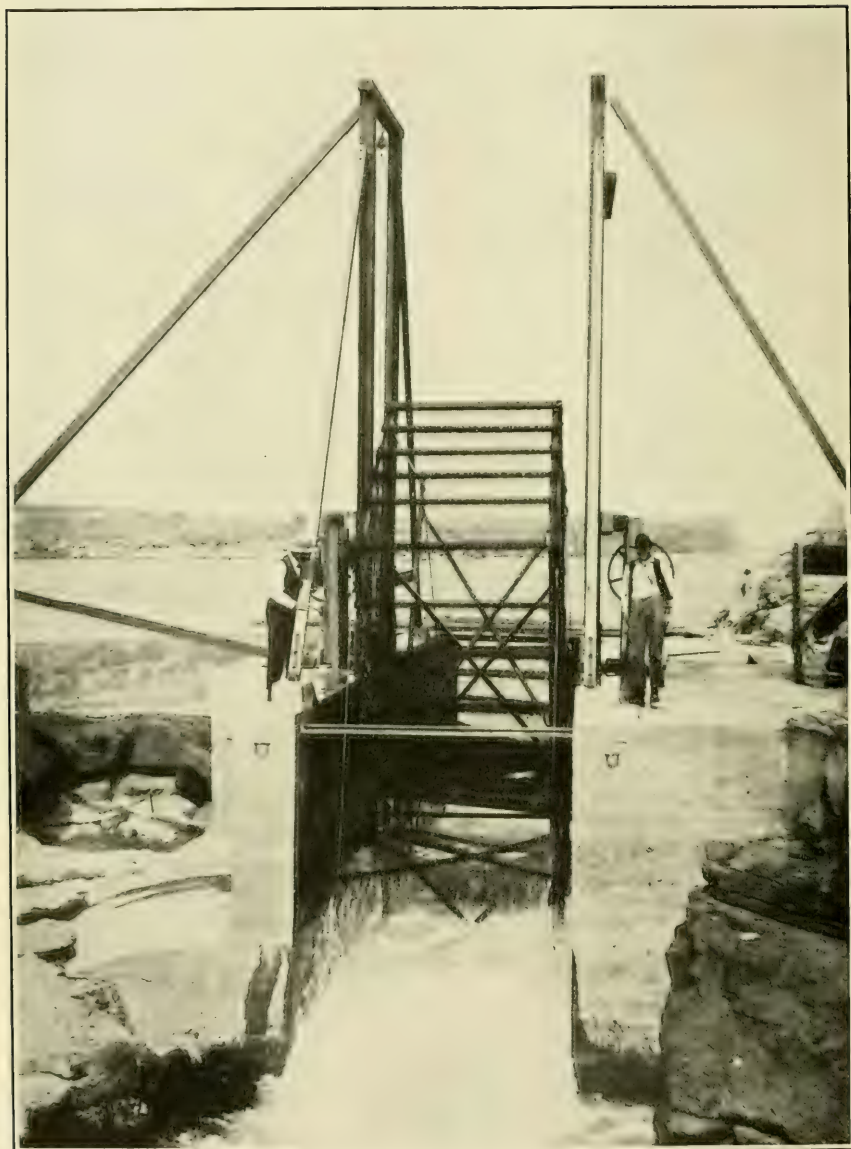


FIG. 25.—A COLUMBIA RIVER STATIONARY FISH WHEEL.

at right angles and discharged into a square box with slat bottom and covered over with boughs. The fish in ascending the stream would be stopped by the rack and in swimming around many of them would be carried by the current into and down the flume, eventually landing in the receiving box alongside the shore.

WHEELS.

Fish wheels are of two kinds, the floating or scow wheel, which can be moved from point to point if need be, and the shore wheel, which is a fixed apparatus. They operate in exactly the same manner, however. The stationary wheel is located along the shore in a place where experience has shown that the salmon pass. Here an abutment is built of wood and stone, high enough to protect it from an ordinary rise in the river. To this is attached the necessary framework for holding the wheel. The latter is composed of three large scoop-shaped dip nets made of galvanized-iron wire netting with a mesh of $3\frac{1}{2}$ to 4 inches. These nets are the buckets of the wheel and they are so arranged on a horizontal axis that the wheel is kept in constant motion by the current, and thus picks up any fish which come within its sweep. The nets are fixed at such an angle that as they revolve their contents fall into a box chute through which the fish slide into a large bin on the shore. The wheels range in size from 9 to 32 feet in diameter and from 5 to 15 feet in width, and cost from \$1,500 to \$8,000, the average being about \$4,000. A number of them have long leaders of piling running out into the river, which aid in leading the salmon into the range of the wheel.

The scow wheel consists of a large square-ended scow that is usually decked at one end and open at the other. Several stanchions, some 8 to 10 feet high, support a framework upon which an awning is spread to protect the fish from the sun's rays and the crew from the elements. To one end of the scow are fastened two upright posts, which are guyed by wooden supports, while projecting from the same end is the framework which supports the wheel, the latter being constructed in the same way as the stationary wheel, but on a smaller scale. In operation the scow is anchored with the wheel end pointing downstream, and as the wheel is revolved by the current, the fish caught fall from the net into a box chute, through which they slide into the scow. As stationary wheels can be used only at certain stages of water, the scow wheel is a necessary substitute to be used at such times as the former can not be operated, or in places where it is not feasible to build a stationary wheel.

The above forms of wheels are used exclusively on the Columbia River.

An ingenious device is used by some of the wheel operators on the Columbia River in getting their catch to the canneries, a few miles farther down the river. The salmon are tied together in bunches, which are attached to air-tight casks and sent down the stream. At the canneries small balconies have been constructed at the water end of the building. A man armed with a pair of field glasses is stationed here, and as soon as he sights one of these casks he notifies a boatman who goes out and tows in the cask and salmon. About 800 pounds of salmon are attached to a keg, and a tag showing the wheel from which shipped, is tied to the fish.

In 1908 the first fish wheel to be located in the coastal waters of Alaska was operated in the Taku River, in southeast Alaska. The wheel was set between two 4-foot scows, stationed parallel to each other, and each 40 feet in length. The wheel had two dips, each 22 feet in width and hung with netting. It could be moved from place to place, the same as the scow wheels on the Columbia River. It was operated throughout the king and red salmon runs, but caught almost no salmon, and was not set in the succeeding years.

For many years the natives of the interior of Alaska have been resorting to the banks of the Yukon and Kuskokwim Rivers and their tributaries in order to secure a sufficient supply of salmon to sustain them through the succeeding winter. The favorite apparatus of these natives at present is a type of fish wheel introduced by the whites about 1905. An oblong framework of timbers is constructed in the water and moored to the bank by ropes. A wheel, composed of two or three dips, is placed in this, the axle resting upon the framework. The current catches each dip in turn, thus causing the wheel to revolve, and the dip is of such shape that the salmon caught roll off it into a trough, down which they slide into a boat moored between the wheel and the shore or into a box fixed to the supporting framework on the side. Although crude in construction, these wheels are very effective and a large number of them are set each season.

The Columbia River fish wheel is a patented device. It was first used by the patentees, S. W. Williams & Bro., in 1879, and for several years they retained a monopoly in its use. A number are now operating on the river. The device was not new even when patented, as a similar "fishing machine," as it is called, had been in use prior to this time and is still used by white fishermen on the Roanoke River in North Carolina.

REEF NETS.

When the whites first visited the Northwest they found the natives employing a number of ingenious devices for catching salmon, and one of the most effective of these was the reef net. J. A. Kerr, Esq.,^a who has been engaged in the salmon fisheries of Puget Sound for a number of years, has written the following very interesting account of this native fishery:

The aborigines the world over have developed ingenuity solely along the lines of their necessities. The coast Indians of Alaska evolved the bidarky and the ingenious implements for taking the seal, the walrus, and the whale. The Siwash of Puget Sound developed a seaworthy dugout and appliances for taking salmon that marks the acme of Indian invention.

When Vancouver explored the waters of the Sound he found over 500 Indians encamped at Chiltenum, now Point Roberts. He relates in his log of the voyage that these Indians were engaged "in fishing for salmon with crude nets made of the bark of young willow." He described the racks upon the contiguous upland used by the Indians in curing the fish.

When Gov. Stevens negotiated the treaty with the Indians of the lower Sound at Point Elliott, now Mukilteo, in 1855, I was informed by Col. Shaw, the interpreter, that over 7,000 Indians attended, the session lasting for five days.

The Government sought to have the Indians confined to reservations, and the disposition of their ancient fisheries was a matter of great solicitude on their part. Salmon was the principal article of their diet.

After protracted discussion the sixth clause of the treaty was made to provide that "the right to take fish at their usual and accustomed fishing grounds, together with the right to erect and maintain racks upon the contiguous upland for curing and drying the same, is hereby forever guaranteed to said Indians."

^a The Siwash Reef Net. By J. A. Kerr. *Pacific Fisherman Yearbook*, 1917, p. 60.

There were two of those ancient fisheries on the lower Sound—Point Roberts Reef and Village Point.

The original reef net of the Indians, as described by the first white settlers and by the Indians themselves, was constructed as follows:

The natives peeled the bark from the willow and with it spun a twine and tied a net about 25 feet in width and 40 feet in length, with a mesh substantially of the dimensions and shape of that used in the now familiar pound net.

They then went into the swamps and cut cedar withes. After heating rocks and placing them in pools of water they steamed these withes, after which they twisted them into substantial ropes.

Their reef net operations were confined to the shoal waters over the reefs. The reef net locations were of great value to the Indians, and were considered as property and handed down from father to son. As a rule the Indian families controlling these locations owned an inner and outer location. The reef at Point Roberts is over 1 mile in length.

Reef net fishing was confined to the flood tide. At the beginning of the flood the outer location was used, after the middle of the flood the nets were shifted to the inner locations.

The Indians assembled at the reefs in advance of the salmon run and prepared their appliances.

They first secured heavy boulders or blocks of sandstone from Chuckanut to be used as anchors. They then procured for each net two logs about the length of their canoes. To each end of these logs they tied one of their ropes, about 100 feet in length, the other end of which was fastened to the stone anchor. These logs were anchored over the top of the reef and about 20 feet apart. From the forward end of these logs there was run out at an angle of 45° other ropes to a distance of 50 feet, the outward end fastened to a buoy. To these ropes were fastened stalks of kelp, the ends weighted to the bottom with stones. Thus was constructed a lead operating to concentrate the approaching school of fish between the logs. Then from the front end of these logs there was dropped forward and to the bottom two ropes, from one of these ropes to the other, at intervals of 2 or 3 feet, were fastened cords of willow twine. This appliance was called by the Indians a ladder.

Now in operating the net itself two canoes were lashed on the inside of the logs. Three Indians occupied one canoe and four the other. The net was then suspended between the canoes. The Indians in the forward end of the canoes held the ropes fastened to the bottom of the net, those in the back end held the ropes fastened to the top of the net. The tide running against the net caused it to bag, or purse. The fourth Indian in one of the canoes was generally an elderly man and was called the watcher. He discovered the school of salmon as they were carried into the net and at his signal the Indians at the front of the canoes pulled the lower edge of the net, which was kept within 4 feet of the surface, above the water. The Indians at the middle of the canoe reached down and caught the sides of the net, lifting the sides above the surface. These Indians pulled against each other, the long ropes by which the logs were moored giving enough to allow the canoes to be pulled alongside each other. The fish were then dumped into one of the canoes, after which the net was loosened and lowered, and the boats fell back to their original position again. With these appliances the Indians would take up to 3,000 salmon on a single run of the tide.

This Indian appliance affords not only an interesting illustration of native ingenuity, but as a matter of fact was the forerunner of the pound net. John Waller, a Welshman, was one of the earliest settlers at Point Roberts. He observed the operations of the reef net and in the early 60's constructed at Point Roberts the first pound net ever driven on the Pacific coast. The leads duplicated that of the Indians, while he impounded the salmon by means of the tunnel leading into a web pot, instead of lifting them as impounded.

The reef net marks the humble Siwash as an inventor of some skill, and as a benefactor of some importance, and the apparatus would be in use to-day were it not for the large number of people required to operate it.

At one time this was a favorite device of the Puget Sound natives for catching sockeye salmon. Owing to the large number of men required to work them, and the fact that they can be worked only at certain stages of tide and in favorable weather, these nets gradually have been supplanted by other devices. In 1909 but five were used, and these were operated off the shores of San Juan, Henry, Stuart, and Lummi Islands, and in the vicinity of Point Roberts. Practically none are used at present.

TROLLING.

Each year the catching of salmon by trolling becomes of increasing importance commercially. Although begun a number of years ago the industry never attained prominence until the mild curers created such a persistent and profitable demand for king, or chinook, salmon that the fishermen, who had previously restricted their operations mainly to the use of nets during the annual spawning runs, which last but a small portion of the year, began to follow up the fish both before and after the spawning run and soon discovered that they were to be found in certain regions throughout nearly every month in the year.

Trolling has several advantages from the fisherman's point of view over seine, gill net, and trap fishing. To engage in it, one does not need any very expensive gear, a boat, hooks, and lines being all that are required. Then, there are no licenses to pay and no seasons to observe in many sections, as the fishing is done in many instances beyond the jurisdiction of State waters.

The fishermen comprise all nationalities. While the majority of them are professionals, men of all walks of life are to be found engaging in the business, some on account of their health, others because of reverses in business or lack of work, while still others engage in it from pure love of the outdoor life.

The Monterey Bay (Calif.) trollers use 48 cotton line generally. A few inches below the main lead an additional line is added, with a small sinker on it. This gives two lines and hooks, and as the main line has but the one lead, and that above the junction with the branch line, it floats somewhat above the latter, which is weighted down with a sinker. The main stem is about 20 fathoms in length, while the branch lines are about 5 fathoms each. These lines cost about \$3.50 each. No spoon is used, but bait almost invariably. A few fishermen use a spread of stout steel wire, 4 feet long, with 5 or 6 feet of line on each end of the spread, two lines and hooks.

On the upper Sacramento River (mainly at Redding and Keswick) some fishing is done with hand lines. A small catch was made here in 1908, but none were so caught in 1909.

Even as early as 1895 trolling was carried on in the Siuslaw River, Oreg., for chinook and silver salmon.

About 1912 the fishermen living along the lower Columbia River discovered that salmon could be taken by trolling off the bar. A number of them went into the business regularly, while their numbers were greatly swelled by the addition of many of the net fishermen during the regular closed seasons on the river, these not applying to trollers. Some idea of the growth of this fishery off the Columbia River bar may be gained when it is stated that in September, 1915, about 500 boats were engaged in it. It is reported that in 1919 over 1,000 boats were engaged in trolling here.

At Oregon City and other places on the Willamette River a number of chinook salmon are caught by means of trolling each year, mainly by sportsmen. A spoon is quite generally employed in place of bait. The fishermen claim that the salmon are not feeding at this time, as their stomachs are shriveled up.

For a number of years the Indians living at the reservation on Neah Bay, Wash., have annually caught large numbers of silver and

chinook salmon in the Strait of Juan de Fuca. A large number of white fishermen also engage in this fishery at the present time in the same waters, while others troll for the same species, but more particularly silvers, in parts of Puget Sound proper. The ordinary trolling line, with a spoon instead of bait, is used.

Many of the trollers use power boats, and in this event four and sometimes six lines are used. One and sometimes two short poles are run out from each side of the boat (when two are used on a side, one is shorter than the other), the butt being dropped into a chock. Two lines are generally trailed from the stern. At the end of each pole is a very short line with a small tin can attached. A few pebbles are in the can, and as the launch moves slowly through the water with all her lines set, the troller knows when he has a bite by the rattling of the pebbles in the can. Each of the lines attached to a pole is also connected with the boat by a short line from the side to a point on the line about 20 feet from the tip of the latter. When a fish is hooked, the fisherman merely pulls in the line by means of the short piece and then can haul the fish in hand over hand.

The most remarkable trolling region is in southeast Alaska. For some years the Indians here had been catching king salmon for their own use during the spring months, and about the middle of January, 1905, king salmon were noticed in large numbers in the vicinity of Ketchikan. Observing the Indians catching these, several white fishermen decided to engage in the pursuit, shipping the product fresh to Puget Sound ports. They met with such success that 271,644 pounds, valued at \$15,600, were shipped. The next year several of the mild-cure dealers established plants in this region, thus furnishing a convenient and profitable market for the catch, and as a result the fishery has grown until in 1915 2,170,400 pounds of king salmon and 54,400 pounds of coho salmon were caught and marketed. The length of the fishing season has also lengthened until now the business is prosecuted vigorously during about seven months in the year, and in a desultory manner for two or three months more, only the severe winter weather preventing operations the rest of the year.

In southeast Alaska the fishermen generally use either the Hendryx Seattle trout-bait spoon No. 5 or the Hendryx Puget Sound No. 8. The former comes in nickel or brass or nickel and brass, the full nickel preferred. The Siwash hook No. 9/0, known as the Victoria hook in British Columbia, is in quite general use. As a rule, but one hook is used, and this hangs from a ring attached to a swivel just above the spoon, while the point of the hook comes a little below the bottom of the spoon. Occasionally double or treble hooks are used. Some fishermen use bait, and when this is done the herring, the bait almost universally employed, is so hooked through the body as, when placed in the water, to stretch out almost straight and face forward as in life.

There are a large number of power-boat trollers in this region. These trollers generally use one pole on a side and one at the stern. The rowboat trollers use but one line, which is attached to a thwart in the boat, handy to their reach when rowing, and trailing out from the stern of the boat.

The trollers usually have temporary camps where they congregate while the fish are to be found in that section, moving on to some more favorable spot when the fish begin to get scarce.

Reports from the trollers of southeast Alaska prove that all species of salmon will take the hook at some time or other in the salt waters of this region, an examination of their stomachs generally showing that they are either feeding or in a condition to feed.

A small commercial fishery is carried on in this region for coho salmon, mainly in August and September, in the neighborhood of Turnabout Island, in Frederick Sound. A Stewart spoon with two hooks on one ring is used, baited with herring in such a way that the fish is straightened out and faced toward the spoon. The sportsmen of Ketchikan also fish with rod and reel for this species in the neighborhood of Gravina Island, using a Hendryx spoon (kidney bait No. 6), which is silvery in color on one side and red on the other. Although much smaller than the king, the coho salmon is more gamey.

During the latter part of March the Gulf of Georgia, in British Columbia, is invaded by large schools of young coho salmon, locally called "bluebacks." They evidently come in from the sea by way of the Straits of Fuca, as their presence is at first apparent in the lower gulf, especially among the reefs and islands off Gabriola Pass. On their arrival these fish are only about a couple of pounds weight, but increase in size very rapidly, with correspondingly voracious appetites. They are to be found in the gulf throughout the spring and summer. By May the fish generally average close to three pounds each when dressed, while in July they are between four and six pounds in weight.

A number of fishermen with power and row boats engage in this fishery, the fish being either sold to the fresh markets or to the canneries.

Trolling lines and spoon baits of one form or another are used. In fishing from power boats the outer lines are attached to fish poles 15 to 18 feet long, rigged out on either side. Those poles are usually hinged at the foot of a short mast and lowered outboard by a halyard running through a block at the masthead, with the additional brace of a forward guy, which, with the drag of the lines aft, holds them in position. It has been customary to use from five to seven lines from each launch, the two outer lines leading from the ends of the poles; the next pair are attached to intermediate tips fastened halfway out on the main pole, while inboard lines are attached to smaller upright rods on either quarter.

The outer trolls are brought within reach (the poles being practically fixtures) by means of a short piece attached to each fishing line 15 or 20 feet from the point where it is fastened to the pole and leading inboard.

Recently, however, the Dominion authorities have decreed that a troller shall not use more than three lines from a boat when trolling for salmon. Should a man be alone in the boat three lines will keep him very busy if the fish are biting at all well.

Spoons are generally used. All shapes are employed, from the ordinary Siwash patterns to wobblers; brass or silver wobblers, of Nos. 4 and 5 sizes, are largely used by the fishermen. Spinners of 2 to 3 inches long are also popular. Copper, copper and silver, and brass

spinners of the Siwash and Victoria patterns are very effective, while red beads, feathered hooks, or a piece of silvery salmon skin placed on the hook as an additional bait often add to the attraction of a spoon.

Quite generally the fishermen use single hooks on their spoons. Various lengths of line are used, but on the average about 60 feet for outside lines and 40 for inside are used. As fish can be landed much quicker with a short line, the fishermen generally shorten their lines to 20 or 30 feet when the fish are biting rapidly. Quite heavy lines are used from the pole to the sinker; from there extends a length of light line, and then a piece of wire, to which the spoon is attached. The sinker, which is usually between 2 and 3 pounds in weight when fishing from a power boat and about 1 pound when a rowboat is employed, is attached to the line about 18 feet from the spoon.

The best fishing times are in the early morning and evening, without regard to tidal conditions. The low slack water is always favorable to good fishing.

These fish are delicate flavored, but do not keep well, it being necessary to rush them to market if they are to be sold in a first-class condition.

Considerable numbers of these fish are taken by both American and Canadian fishermen on Swiftsure Banks, off Cape Flattery. As complaint had been made in 1914 that these fish were immature and were unfit for canning because of their appearance after being out of the water some hours, H. T. Graves, acting commissioner of agriculture for the State of Washington, which department is concerned with the wholesomeness of food products, made a thorough investigation of their fitness for food. In a letter to the *Pacific Fisherman*, Seattle, Wash., and published in that journal under date of August, 1914, he states, among other things, the following:

The question, therefore, for us to determine was to ascertain their value as a food product. The condition of these fish arriving at the various canneries was carefully noted; samples were selected for bacteriological analysis.

The fish when first taken from the water are very soft when compared with the other salmon. After they have been out of the water 12 hours the fish easily separates from the bony structures, and in the course of ordinary handling in the time which elapses between the hour of taking from the water until they are offered for packing at Sound canneries, which is anywhere from 12 to 48 hours, they become badly broken up and present a rather ugly and distasteful appearance, to say the least.

We found that many different methods of handling were being experimented with by the fisherman and by Puget Sound canneries, but without any noticeable effect. While from a physical observation one would imagine these fish as received at the Sound canneries to be unwholesome, a bacteriological examination by Dr. E. P. Fick, State bacteriologist, indicated that putrefaction was not present, although some of the specimens did contain a rather high bacteria count.

BOW AND ARROW.

On the Tanana River, a tributary of the Yukon River, in Alaska, the Indians hunt salmon in birch-bark canoes with bow and arrow. As the canoe is paddled along and the Indian sees the dorsal fin of the salmon cutting the surface of the muddy water he shoots it. The tip of the arrow fits into a socket, and when struck the tip, which when loose is attached to the stock by a long string, comes out of the socket and the arrow floats, easily locating the fish for the fisherman.

SPEAR AND GAFF.

Spears of varying shapes and styles have been in use by the Indians from time immemorial and are still employed on many rivers in which salmon run. With the exception of the Chilkoot and Chilkat Rivers of Alaska, practically all of the catch secured in this manner is consumed by the fishermen and their families. In the Chilkoot River the Indians have built numerous racks in the stream and on the banks, upon which they stand and hook the fish out with a gaff attached to a pole. The catch is sold to the cannery located on Chilkoot Inlet.

SPORT FISHING FOR SALMON.

The number of sportsmen who improve the opportunity presented by the appearance of feeding springs and cohos is increasing yearly, and in time this promises to far excel the sport salmon fishing of the Atlantic coast.

On Puget Sound and lower British Columbia waters the anglers generally use ordinary trout fishing rods and tackle, with preferably a short trolling tip on the rod when out for coho. Small spinners of silver or copper, of about an inch in length, or else the small double Tacoma spoons, are very good. A strong gut leader or trace of fine piano wire is frequently used, as the fish's teeth would cut through an ordinary line. Where iron wire is used the salt water rusts it rapidly, and unless the precaution is taken to dry off the wire and oil it after using it can not be used for more than a couple of days. Sinkers of an ounce or two in weight are generally employed with fine line.

Many of the small spoons on the market have very cheap hooks, and these are apt to straighten out or break with the strain of a large fish. Hooks of the best steel will, however, stand up to this strain.

One of the favorite spots for anglers is at the falls on the Willamette River at Oregon City, Oreg. Another is on the Clackamas, a tributary which debouches into the Willamette near here. When the spring run of salmon appears in April, hundreds of anglers, many of them from far distant points, appear to participate in the sport during this month and in May. Many noted sportsmen have fished for salmon at these spots. Among them was Rudyard Kipling,^a and his experiences were woven into a classic short story.

The fishing ground is spread over a mile's length of the river, from Clackamas rapids to the deadline at the falls. It is not an uncommon sight to see 500 boats, each containing from one to six fishermen and fisherwomen, dotting the river on favorable days during the season.

Two methods of fishing are followed. The most popular is to anchor at the head of the Clackamas rapids or in swift water near the falls and allow the rush of water to spin the trolling hook. In the longer lengths of quieter water the sportsmen troll in slow motor boats or rowboats.

An inexperienced boatman is apt to find fishing in the rapids or near the falls somewhat dangerous, as the swift water may overturn his craft and carry him to his death before help can reach him.

There is a fishway in the dam, so that the fish can pass up this and into the river above the dam. No fishing is allowed closer than 100

^a It was in 1889 that Kipling fished here, and his story was reprinted in *The American Angler*, Vol. II, No. 2, December, 1917, pp. 415-420.

feet of the mouth of this ladder. Up to 1915 there was a second deadline, 600 feet from the falls, beyond which no commercial fisherman could operate nets, but the Oregon Legislature in that year closed the Willamette to all net fishermen from the Clackamas rapids to the falls.

The salmon in the spring run on the Willamette will average about 25 pounds each, but examples weighing 50 pounds and over are not uncommon.

In 1914 the Salmon Club of Oregon was formed of anglers who desired to encourage the use of light tackle in the taking of large game fish, in place of the extremely heavy tackle heretofore used. The following rules were adopted:

The rods used may be made of any material except solid bamboo cane. They must not be less than 5 feet in length and weigh not over 6 ounces.

The line must not be heavier than the standard nine-thread linen line.

Any style of reel or spoon may be used and the wire leader must not exceed 3 feet in length.

The angler must reel in his fish, bring it to gaff unaided, and must do the gaffing himself. If a rod is broken at any time during the struggle with the fish it will disqualify the catch.

As a reward of merit the club awards bronze buttons to all anglers taking, on light tackle, salmon weighing 20 pounds or over; for a fish weighing over 30 pounds a silver button is given, and for any salmon over 40 pounds the lucky angler receives a gold button. Numerous additional prizes are also given by public-spirited citizens.

The season for light tackle on the Willamette River and all other inland streams of Oregon has been fixed by the club from January 1 to July 1.

In 1915 the first angler to win a gold button on the Willamette River did so on April 18, when he took a 42½-pound salmon. On the same day this same angler also won a silver button for a 32½-pound fish and a bronze button for a 26-pound fish.

DANGERS TO THE INDUSTRY.

Man is undoubtedly the greatest present menace to the perpetuation of the great salmon fisheries of the Pacific coast. When the enormous number of fishermen engaged and the immense quantity of gear employed is considered, one sometimes wonders how any of the fish, in certain streams at least, escape. High water or low water, either of which will prevent certain forms of apparatus from fishing to any extent while such conditions prevail, storms which impede fishing, and the hundred and one small things which in the aggregate are of considerable importance, however, all aid in assisting the salmon in dodging the apparatus and reaching the spawning beds in safety, while, unless the stream is completely blocked by a tight barricade, an indeterminate number of salmon will escape all the pitfalls man and animals may set for them.

In some sections an almost idolatrous faith in the efficacy of artificial culture of fish for replenishing the ravages of man and animals is manifested, and nothing has done more harm than the prevalence of such an idea.

While it is an exceedingly difficult thing to prove, the concensus of opinion is that artificial culture does considerable good, yet the very fact that this can not be conclusively proven ought to be a warning to all concerned not to put blind faith in it alone.

When salmon are stripped by man, the eggs fertilized and retained in hatcheries until the young are born, and then planted as soon as the yolk sac has been absorbed, it is manifest that the only saving over the natural method is in reducing the loss in the egg stage. We know that many eggs, after being deposited naturally on the spawning beds, are devoured by other fishes, while sudden freshets and occasional droughts also claim their toll of eggs. It is highly probable, although we have no positive data on this point, that these losses far exceed those experienced in artificial salmon culture, and whatever this difference is it represents the extent to which salmon hatcheries should be credited as preservers of the industry.

In the opinion of the author, the best way in which to conserve the fisheries of the coast is by enacting and enforcing laws under which a certain proportion of the runs will be enabled to reach the spawning beds and perform the final and most important function of their lives unmolested. If this is done, there can be no question of the perpetuation of the industry, and if it is then supplemented by the work of hatcheries, which would reduce the loss in the egg stage, assurance on this point would be made doubly sure.

If unrestricted fishing is to prevail, however, with a dependence upon hatcheries alone to repair the ravages of man, the industry will suffer seriously, for, from the very nature of things, less and less fish will annually escape through the fishing zone, resulting in a continually lessening quantity of eggs being obtained at the hatcheries, and finally the latter will have to close down from sheer lack of material upon which to work.

Should eggs be brought to the hatchery from other streams, it would merely be "robbing Peter to pay Paul," and in the end the same result would follow in those streams.

Fortunately these matters are becoming increasingly plain to the people of the various States, provinces, and territories concerned, and, while a few selfish persons in each are seeking solely their own enrichment by any means possible, the greater number of those interested in fishing operations want to see the industry perpetuated and are willing to do almost anything that will work to this end.

The rapid increase, during recent years, of salmon trolling and purse seining on the feeding banks off the mouth of the Columbia River and outside the Strait of Juan de Fuca and elsewhere on the coast has resulted in the taking of large quantities of small and immature salmon, and alarm is now felt lest the runs of chinooks and cohos be seriously depleted. Several thousands of large and small boats are being operated on these grounds from five to eight months of the year, and while, when prices were comparatively low, but few of these immature fish were marketed, the high prices which have prevailed during the last four years have caused such an intensity of fishing that many thousands are now caught each season.

Investigations^a by experts off the mouth of the Columbia in 1918 show that a large proportion of the chinook salmon caught by trolling are 2 and 3 years old. These are generally sold to the cannery, who separate them into two groups, those under 5 pounds and those over. Those under 5 pounds are called "graylings" by the fishermen, but a mere glance at them is sufficient to establish their real identity. The

^a The Taking of Immature Salmon in the Waters of the State of Washington. By E. Victor Smith. State of Washington, Dept. of Fisheries. 44 pp., 8 pls. 1920.

reports of one cannery during the period from May 11 to May 29 showed there had been received 4,061 pounds of these fish, none of which weighed 5 pounds. From May 30 to June 12 this same cannery received 548 of these fish having a total weight of 1,483 pounds. As the owner of this cannery was decidedly opposed to the purchase of these fish, and only bought them because his regular fishermen would have gone to other cannerymen with their full-sized fish had he not taken the immature ones, it is probable that the cannerymen who were not opposed to the practice received a greater proportion of immature fish than he.

An idea of the smallness of these immature salmon may be gained when it is stated that the average weight of sexually mature chinook salmon running into the Columbia River is about 22 pounds.

These small chinooks are said to produce a very inferior quality of canned goods, being rated as second and third grade. The meat is of an ashy color, poor in fat content, and insipid in taste.

Off the Strait of Juan de Fuca the same condition of affairs existed as off the Columbia River, with the added complication that many immature cohos were also captured.

The immature feeding coho deteriorates when taken from the water even more rapidly than does the immature feeding chinook. Within 24 hours of being taken from the water the abdomens may be broken open, the ribs protrude freely, and the flesh begins to deteriorate. It was early found that it was impossible, except through the exercise of extraordinary precautions, to get these fish to the up-sound canneries before it was too late, so that of recent years only canneries situated adjacent to the banks were enabled to use them.

The sale of young salmon in the fresh fish markets of Seattle and other Puget Sound cities has been common for years. They are marketed usually as "salmon trout."

It is an economic crime to catch and kill these immature salmon, as but little money is obtained for them, while if they were allowed to attain maturity they would increase in weight, in the case of the chinook nearly 1,000 per cent on the average and in the case of the coho about 100 per cent in four or five months time.

Another bad feature of trolling operations off the mouth of the Columbia River is that trollers, because they operated outside the 3-mile limit, were exempted from the observance of the regular closed season, operative in the river from August 25 to September 10. As a result of this, fishing was carried on continuously throughout the run; most of the gill netters who had to stop fishing in the river put their nets ashore and went outside and engaged in trolling, while canneries on the river bought and canned all the fish brought in. In 1917 the Washington Legislature enacted a law prohibiting possession within the State during the closed season, except for personal use, of salmon caught beyond the 3-mile limit outside the Columbia River. The State court, on trial, held this to be unconstitutional as being an interference with interstate and foreign commerce.

Oregon also adopted the same law as Washington, and on trial this was upheld as constitutional on October 3, 1919, by the Oregon circuit court. However, the law will be of no value if valid in only one State, as if enforced there the fishermen will sell their catches in the other State.

It is quite plain that the salmon runs entering the Columbia River and the Strait of Juan de Fuca can not long continue to exist under this terrific drain upon the immature and mature fish. In the latter section the sockeyes and humpbacks are rapidly being exterminated, and it is probable that the chinooks and cohos, the especial victims in this attack, will soon show signs of exhaustion.

The State authorities appear to be helpless in these matters, but an enactment by the Federal Government could be maintained, as the principle has been applied to fishery matters elsewhere, notably the spring mackerel closed season for five years and the sponge law relating to the landing of undersized sponges taken from the grounds off the Florida coast.

Next to the fishing operations of man, the gravest danger to the salmon fisheries of the Pacific coast lies in the pollution of the rivers which the salmon ascend for spawning purposes. The salmon, both old and young, require pure cold water, and the immense runs which have annually ascended the streams for many years are doubtless due to the fact that such conditions have prevailed in them. The large increase in the population of the coast States within recent years, with the resulting increase of mills and factories, has greatly increased the amount of sewage from cities and towns and the waste of the manufacturing plants. Many of the latter have also constructed dams without adequate fishways, and these also wreak great havoc to the industry by cutting the fish off from the upper reaches of the rivers upon which constructed.

The emptying of sewage into streams ought to be made a crime. It is an exceedingly crude method of dealing with it, and, instead of disposing of the filth, merely transfers it from one place to another, making the water unfit for use at points farther downstream and spreading diseases and death amongst not only the finny but also human users of it.

In the present condition of sanitary science it is a comparatively easy matter to dispose of this filth by modern septic devices, and a number of cities are now disposing of their sewage in this manner.

The irrigation ditch, a comparatively new product on this coast, while of great benefit in developing the arid lands in certain sections, as at present operated is a considerable menace to the salmon fisheries. But few ditches have screens at their head, and as a result many thousands of young salmon slowly making their way to the ocean home pass into and down these to an early doom. Every owner of such a ditch should be compelled to place at its head a screen with fine enough mesh to prevent absolutely the passage through the same of even the tiniest baby salmon.

Next to man and his methods the trout is undoubtedly one of the greatest enemies of the salmon. The Dolly Varden follow the salmon from the sea to the spawning beds, and when the eggs are extruded devour countless thousands of them. Many and many a time the writer has seen on the spawning beds female red salmon swimming around with a cloud of trout spread out behind like a fan, following her every movement, eagerly waiting for the moment when the eggs shall appear.

In the summer, when the young are heading for the sea, the trout are lying in wait for them and again take their toll of countless thousands.

Much is said by certain people of the ravages amongst the salmon of certain animals, as the seal, sea lion, bear, eagle, kingfisher, crane, duck, loon, and hawk. While in the aggregate the ravages of these animals are considerable, they are not a drop in the bucket as compared with the direct or indirect ravages of man and his agencies.

FISHING SEASON IN ALASKA.

There is much interest manifested in the beginning and end of the salmon-fishing season for the more important waters of the various regions of Alaska. The following table, extracted from United States Bureau of Fisheries Document No. 838, "Alaska Fisheries and Fur Industries in 1916," pages 48 and 49, gives dates taken from the statistical reports made by the canning companies. The earliest one reported by any company doing much fishing has been accepted as an opening date, while the closing date was determined by taking the day nearest to which major operations ceased.

FISHING SEASON IN THE CANNING INDUSTRY FOR SALMON CAUGHT IN CERTAIN IMPORTANT WATERS IN ALASKA IN 1916.

| Locality. | Coho. | | Chum. | |
|--|----------------|----------------|----------------|----------------|
| | Fishing began— | Fishing ended— | Fishing began— | Fishing ended— |
| Southeast Alaska: | | | | |
| Chatham Strait..... | June 1 | Sept. 27 | June 1 | Sept. 30 |
| Prince of Wales Island, west side..... | June 15 | Sept. 23 | July 1 | do. |
| Cordova Bay..... | do. | do. | do. | do. |
| Clarence Strait— | | | | |
| Southern section..... | June 10 | Sept. 29 | June 27 | Sept. 29 |
| Northern section..... | July 20 | Sept. 30 | Aug. 13 | Oct. 17 |
| Behm Canal..... | June 15 | Oct. 20 | June 15 | Oct. 20 |
| Revillagigedo Channel..... | June 27 | Sept. 29 | June 27 | Sept. 29 |
| Stephens Passage..... | July 4 | Oct. 4 | June 22 | Oct. 3 |
| Peril and Sumner Straits..... | June 24 | Sept. 27 | July 1 | Sept. 30 |
| Frederick Sound..... | June 22 | Sept. 21 | Sept. 14 | Sept. 23 |
| Icy Strait and Cross Sound..... | June 15 | Sept. 20 | May 29 | Sept. 27 |
| Lynn Canal..... | July 7 | Oct. 1 | July 7 | Oct. 1 |
| Baranof Island, west side..... | July 4 | Sept. 20 | June 20 | Sept. 20 |
| Chichagof Island, west side..... | Aug. 15 | Sept. 15 | Aug. 5 | Sept. 15 |
| Portland Canal..... | Aug. 16 | Sept. 9 | July 8 | Sept. 3 |
| Iphigenia Bay..... | June 8 | do. | do. | do. |
| Yakutat Bay and vicinity..... | Aug. 25 | Sept. 28 | do. | do. |
| Central Alaska: | | | | |
| Bering River..... | | | | |
| Martin River..... | | | | |
| Copper River Delta..... | May 12 | Sept. 24 | May 12 | Sept. 24 |
| Copper River, lake and canyon..... | May 31 | Sept. 16 | May 31 | Sept. 16 |
| Controller Bay..... | Aug. 24 | Sept. 25 | | |
| Cook Inlet..... | July 2 | Aug. 27 | June 24 | Aug. 23 |
| Prince William Sound— | | | | |
| Eastern section..... | July 1 | Sept. 30 | June 23 | Sept. 24 |
| Western section..... | | | July 7 | Aug. 4 |
| Afognak streams— | | | | |
| Western part..... | | | | |
| Eastern part..... | Aug. 15 | Oct. 20 | | |
| Karluk..... | June 3 | Oct. 2 | June 3 | Oct. 2 |
| Red River..... | | | June 8 | July 21 |
| Umuk..... | Aug. 15 | Oct. 10 | | |
| Olga Bay..... | June 8 | Sept. 1 | June 8 | Sept. 1 |
| Chignik Bay..... | June 28 | Sept. 9 | June 12 | Sept. 8 |
| Ikatan Bay..... | May 22 | July 25 | May 22 | July 25 |
| Cold Bay, Thin Point, and King Cove..... | June 28 | Aug. 15 | June 28 | Aug. 15 |
| Morzhovoi Bay..... | June 9 | Aug. 11 | June 9 | Aug. 11 |
| Pavlof Bay..... | | | | |
| Western Alaska: | | | | |
| Kvichak Bay..... | June 11 | Aug. 1 | June 11 | Aug. 1 |
| Naknek, Ugaguk, and Ugashik Rivers..... | | | June 21 | July 31 |
| Nushagak Bay..... | June 11 | Aug. 4 | June 11 | Aug. 4 |
| Nushagak River..... | June 24 | Aug. 6 | June 23 | Aug. 6 |
| Port Moller..... | June 7 | Aug. 9 | June 7 | Aug. 9 |
| Nelson Lagoon..... | | | July 1 | Aug. 7 |
| Kotzebue Sound..... | July 20 | Sept. 1 | | |

FISHING SEASON IN THE CANNING INDUSTRY FOR SALMON CAUGHT IN CERTAIN IMPORTANT WATERS IN ALASKA IN 1916—Continued.

| Locality. | Humpback. | | King. | | Red. | |
|--|----------------|----------------|----------------|----------------|----------------|----------------|
| | Fishing began— | Fishing ended— | Fishing began— | Fishing ended— | Fishing began— | Fishing ended— |
| Southeast Alaska: | | | | | | |
| Chatham Strait..... | June 1 | Sept. 30 | June 1 | Sept. 22 | June 1 | Sept. 12 |
| Prince of Wales Island, west side..... | July 1 | do. | | | June 15 | Sept. 23 |
| Cordova Bay..... | June 15 | do. | | | do. | Do. |
| Clarence Strait— | | | | | | |
| Southern section..... | June 27 | Aug. 16 | | | June 8 | Sept. 29 |
| Northern section..... | Aug. 13 | Oct. 17 | June 27 | Aug. 30 | July 13 | Sept. 7 |
| Behm Canal..... | June 15 | Oct. 20 | | | June 15 | Oct. 16 |
| Revillagigedo Channel..... | June 27 | Sept. 29 | June 16 | July 16 | June 27 | Sept. 29 |
| Stephens Passage..... | June 22 | Sept. 21 | May 9 | July 12 | June 21 | Oct. 3 |
| Periland Sumner Straits..... | June 21 | Sept. 30 | | | June 27 | Sept. 9 |
| Frederick Sound..... | | | | | June 22 | Sept. 21 |
| Icy Strait and Cross Sound..... | June 1 | Sept. 27 | May 21 | July 15 | May 21 | Sept. 15 |
| Lynn Canal..... | July 7 | Aug. 24 | | | June 24 | Oct. 1 |
| Baranof Island, west side..... | June 20 | Sept. 20 | | | June 8 | Sept. 20 |
| Chichagof Island, west side..... | Aug. 1 | Sept. 15 | | | Aug. 1 | Sept. 1 |
| Portland Canal..... | July 8 | Sept. 3 | | | July 8 | Aug. 18 |
| Iphigenia Bay..... | June 8 | Sept. 9 | | | June 8 | Sept. 9 |
| Yakutat Bay and vicinity..... | July 15 | Aug. 10 | June 2 | Aug. 4 | June 2 | Aug. 4 |
| Central Alaska: | | | | | | |
| Bering River..... | | | June 22 | June 28 | June 6 | Aug. 7 |
| Martin River..... | | | May 12 | July 9 | June 12 | July 9 |
| Copper River Delta..... | May 12 | Sept. 21 | do. | do. | May 12 | Aug. 15 |
| Copper River, lake and canyon..... | May 31 | Sept. 16 | May 31 | Sept. 16 | May 31 | Sept. 16 |
| Controller Bay..... | July 23 | Aug. 8 | | | May 27 | Aug. 15 |
| Cook Inlet..... | June 27 | Aug. 27 | May 27 | Aug. 27 | May 30 | Aug. 27 |
| Prince William Sound— | | | | | | |
| Eastern section..... | June 28 | Sept. 24 | | | June 20 | Sept. 24 |
| Western section..... | July 9 | Aug. 1 | | | June 17 | July 23 |
| Afognak streams— | | | | | | |
| Western part..... | June 20 | Aug. 15 | | | May 15 | July 31 |
| Eastern part..... | July 15 | Sept. 16 | | | June 1 | Oct. 20 |
| Karluk..... | June 3 | Oct. 2 | June 3 | Oct. 2 | June 3 | Oct. 2 |
| Red River..... | June 8 | July 21 | | | June 8 | July 21 |
| Uganik..... | June 5 | Oct. 10 | | | June 5 | July 27 |
| Olga Bay..... | June 8 | Sept. 1 | June 8 | Sept. 1 | June 8 | Sept. 1 |
| Chignik Bay..... | June 12 | Aug. 31 | June 12 | Aug. 31 | June 12 | Sept. 9 |
| Ikatan Bay..... | May 22 | July 25 | May 22 | July 25 | May 22 | July 25 |
| Cold Bay, Thin Point, and King Cove..... | June 28 | Aug. 15 | | | June 28 | Aug. 15 |
| Morzhovoi Bay..... | June 9 | Aug. 11 | June 9 | Aug. 11 | June 9 | Aug. 11 |
| Pavlov Bay..... | Aug. 7 | Aug. 15 | | | | |
| Western Alaska: | | | | | | |
| Kvichak Bay..... | June 11 | Aug. 1 | June 11 | Aug. 1 | June 11 | Aug. 1 |
| Naknek, Ugashik, and Ugashik Rivers..... | | | June 21 | July 31 | June 21 | July 31 |
| Nushagak Bay..... | June 11 | Aug. 4 | June 11 | Aug. 4 | June 11 | Aug. 4 |
| Nushagak River..... | June 17 | Aug. 6 | June 8 | July 28 | June 13 | Aug. 6 |
| Port Moller..... | June 7 | Aug. 9 | June 7 | Aug. 9 | June 7 | Aug. 9 |
| Nelson Lagoon..... | | | do. | July 21 | do. | Aug. 7 |
| Kotzebue Sound..... | | | | | | |

FISHERMEN AND OTHER EMPLOYEES.

FISHERMEN.

White men do the greater part of the fishing for salmon, many nationalities being represented, but Scandinavians and Italians predominate almost everywhere. A number of Greeks are to be found fishing in the Sacramento, while Slavonians do most of the purse seining on Puget Sound. The native-born American is not often found actually engaged in fishing, but frequently is the owner of the gear or has a responsible position in the packing plants.

A number of Indians participate in the fisheries of Alaska and a few fish in Washington. The only Chinese engaged in fishing are in Monterey Bay. A number of Japanese also fish in this bay, which is the only place in American territory where they fish for salmon. A considerable number of Japanese engage in fishing in Canadian waters.

In many places on the coast, particularly in Alaska, fishing is a hazardous occupation. In Alaska most of it is done in the bays, sounds, and straits, where storms are frequent, and the annual loss of life is heavy. The records of the Alaska Fishermen's Union show for its members the following losses of life by drowning: 1905, 10 men; 1906, 5 men; 1907, 10 men; 1908, 17 men; and 1909, 17 men.

The fishermen early saw the advantages of organization, and nearly every river now has a union which is subordinate to the general organization. One of the most typical of these is the Alaska Fishermen's Union, which has active jurisdiction over all sections of Alaska except a portion of southeast Alaska. This organization enters into contracts with the salmon canneries and salteries, by which the rates of wages, duties, etc., of the fishermen are fixed in advance for a certain period—three years—up until 1918, when an agreement was made for only one year. The same was true in 1919. As a result of this mutual agreement upon terms but little trouble is experienced with the fishermen, who generally conform scrupulously to the terms of the contract, and strikes and bickerings, which were very common some years ago, are now almost entirely absent.

CANNERY LABOR.

NATIONALITIES.

In the early days canning was a haphazard business and workmen came and went as common laborers do in the wheat fields of the West. As the business increased in importance and the need of skilled labor became imperative, men were put to certain work and kept at it from season to season, with the result that in a few years a corps of highly skilled workers had been evolved, and this had much to do with the rapid extension of the industry.

For many years Chinese formed the greater part of the cannery employees, the superintendent, foreman, clerks, machinists, and watchmen alone being white. No other laborers have ever been found to do the work as well or with as little trouble as the Chinese. In times of heavy runs, when the cannery would have to operate almost day and night in order to take advantage of what might be the last run for the season of the sometimes erratic salmon, the Chinese were always willing, even eager, to do their utmost to fill the cans, and, if fed with the especial food they insisted upon having and due regard was had to certain racial susceptibilities, the cannery man could almost invariably depend upon the Chinese doing their utmost.

The Chinese-exclusion law cut off the supply of Chinese, and as the years went by and their ranks became decimated by death, disease, and the return of many to China, the contractors were compelled to fill up the rapidly depleting crews with Japanese, Filipinos, Mexicans, Porto Ricans, etc., with the result that to-day in many canneries special quarters have to be provided for certain of the races—more particularly the Chinese and Japanese—in order to prevent racial hatred from engendering brawls and disturbances.

In Alaska the Japanese now compose about one-half of the cannery employees. While a few cannery men express themselves as well pleased with this class of labor, the majority find it troublesome.

In Alaska and at a few places in the States Indians are employed in the canneries. In Alaska more would be employed if they could be secured. They make fair work people, but are rather unreliable about remaining through the season.

CHINESE CONTRACT SYSTEM.

Cannery labor is supplied largely through the contract system. In the large cities along the coast are agencies, mainly owned by Chinese, which make a specialty of furnishing labor for canning. In the agreement between the canning company and the contractor the company guarantees to pack a certain number of cases during the coming season, and the latter agrees to do all the work from the time the fish are delivered on the wharf until they are ready to ship at the end of the season for a certain fixed sum per case. Should the cannery pack more than the guaranteed number, which it usually does if possible, the excess has to be paid for at the rate per case already agreed upon, while if the pack for any reason should fall below the contract amount, the company must pay for the shortage the same as though they had been packed. The company transports the Chinese to the field of work and carries them to the home port at the end of the season. It provides them with a bunk house and furnishes fuel, water, and salt. The contractor sends along with each crew a "boss," who has charge of the crew and furnishes their food, the company transporting this free.

While this contract system met with favor from some of the cannery men because it relieved them from the annoyance and trouble involved in hiring, working, and feeding their cannery gangs, others, and these the most farsighted, from the early days of the industry viewed it with suspicion and distrust and in a few instances refused to have anything to do with it. While the plan apparently met with no objection from the Chinese when they were the only ones engaged in the work, as soon as other races began to be employed disputes became common, and it is probable that to-day it is the most unpopular feature of the industry from the common workers' standpoint, and mainly because of the abuses which have grown up in connection with it.

Since the beginning of the present century there has been a steady expansion of the salmon-canning industry, with a consequent heavy demand for cannery labor. As a result of the operation of the Chinese-exclusion act during this period the number of Chinese available has been steadily declining; in fact, most of the Chinese now employed are mainly men well along in life, as the few comprised in the rising generation do not wish to follow in their fathers' footsteps. As a result the oriental gang now comprises many nationalities.

The great increase in the number of canneries during the period noted, with the resulting demand for labor, led to the introduction of other nationalities, more notably the Japanese, into the ranks of the Chinese contractors. Many of these operated with very little or no capital and when a bad season occurred they usually passed their losses, in whole or in part, onto their workers, usually by absconding, and when the latter attempted to come back onto the owner of the plant the latter successfully pleaded the fact that he had made a contract with the contractor to do the work at a certain fixed sum

per case, that the stipulated price had been paid him, and if he failed to settle with the men it was no concern of the canner.

The contractor, under his agreement with the canner, has the right to feed his employees from the time they leave the home port until they return, and this is a most prolific source of profit and graft to him and of trouble to the canner. When the workers comprise orientals alone, the food question rarely troubles as then rice, which is the staple food and is also as a rule quite cheap, meets with the approval of all. But since the gangs now comprise almost as many nonorientals as there are orientals, and the former find it impossible to exist, let alone thrive, on rice, much trouble results when the contractor furnishes them with an undue proportion of the latter in the daily menu. As a result of this condition of affairs, some of the more far-seeing companies now compel the contractor to furnish each nationality with food to which they are accustomed and in sufficient quantities. Eternal vigilance is required in this matter, however, as the wily oriental is always seeking an opportunity to increase his profits by cutting the quantity of food to the minimum and by forcing as much rice as possible upon the employees. Innumerable strikes in the canneries can be traced directly to dissatisfaction with the quantity, kind, and quality of food furnished to the men by the contractor's agent; and the resulting losses, which are sometimes very large, as the strikes generally occur when the cannery has plenty of fish, fall upon the cannery men.

Nearly all of the workers are ignorant men; in most cases they have but little knowledge of English, the language in which the contract is printed, and as no paternal Government watches over them to see that they understand thoroughly the terms of the contract and that it is fulfilled on the part of the employer, as is done in the case of the sailors and fishermen, some of them discover at the end of the season that their pay does not come up to the glowing promises of the agent who recruited them and also frequently discover that there are various fines provided for in the contract, which, while they do not work an injustice when the contractor is honest, yet in the hands of an unscrupulous and grasping contractor, frequently operate to the financial disadvantage of the worker.

Some of the dishonest contractors have developed other methods for fleecing their employees. Sometimes they will furnish to their contract workers, either directly or through some concern in which they have financial interests or which will pay them a commission, an outfit comprising clothing, blankets, shoes, etc., at a price two or three hundred times its real value. The worst feature of many of these outfits is that they are woefully inadequate for use in the climate to which the cannery ship is bound. Some unscrupulous contractors also sell goods to the workers at extortionate prices while at the cannery. The latter is usually not permitted by the cannery, who generally operate a store of their own where the men can as a rule obtain goods as cheap as they can be bought in either San Francisco or Seattle.

Orientals are inveterate gamblers, and there are usually several sharpers with each cannery gang, generally with the connivance of the contractor's agent—although it is usually an impossibility to prove this legally—and they inveigle the green hands into all sorts of gambling games, and in this manner frequently succeed in winning

all or part of their season's wages. That those in charge of the gang are well aware of what is going on is patent when it is stated that the men are not paid off until they return to the home port at the end of the season, and that no considerable claim on the wages due a worker can be paid unless the contractor or his agent knows what it is for. Sometimes when dealing with a canner who is insistent upon seeing justice done to the members of the oriental gang, and the number of these is increasing rapidly, an effort is made to camouflage these gambling debts by charging them up on the books as clothing or goods furnished the worker.

As a result of these evils, a number of the cannerymen have discontinued the practice of making Chinese contracts and deal directly with their men. When this is done, it is but rare to hear of a strike due to food supplied, as the cannerymen, when the matter is put directly up to them, realize that the only way in which they can expect adequate work from their employees is by seeing that they are given the proper kind and quantity of food and that they operate under decent working and living conditions.

A few of the cannerymen who still retain the old system endeavor to eradicate so far as possible the evils of it by a close supervision over the food supplied the men and by having a representative present at the season's pay-off in order to see that no attempt is made to cheat the men out of their wages. Unfortunately, however, some of them feel that they have done their full duty when they have made a contract with someone, no matter what his financial responsibility may be, and have paid him the agreed upon sum at the end of the season, doubtless feeling that the rest is the concern alone of the men.

In a very few instances the members of the oriental gang are still shoved into inadequate and insanitary quarters aboard ships, and at the canneries are housed in quarters which are a disgrace to any modern packing plant, but, fortunately, these conditions, as stated, prevail now with but comparatively few of the companies. The old "China" house, in which was housed the whole oriental gang like rabbits in a warren, has been largely superseded by cottages, each housing from 8 to 16 men, and these are numerous enough to permit of the various nationalities flocking by themselves. Bathing facilities, with hot and cold water, are fairly common, and opportunities for washing clothing are frequent.

FISHERIES OF BOUNDARY WATERS.

Waters which form the boundaries between States or between nations, and in which fishing is carried on by the citizens of both, have almost always proved bones of contention, and the Pacific coast has been no exception to the rule.

WASHINGTON AND OREGON.

The Columbia River, which forms the boundary between Oregon and Washington, affords a typical example of the evils which can result from a division of responsibility between two States. For many years each State enacted laws regulating the fisheries of the river with very slight regard usually to laws already in force in the other State. As a result of this the fishermen transferred their

residence for license purposes from State to State as the laws of one or the other best suited their particular purposes.

The fishermen and packers also were in apparently irreconcilable conflict as to the proper means to be taken to conserve the fisheries, and each session of the legislatures saw strong lobbies present to work for certain selfish ends, while the few earnest men who had the real welfare of the fisheries of the river at heart had difficulty in making the slightest headway against the influence of these lobbies.

To further complicate the matter, in 1894 Oregon claimed that, under the provisions of the enabling act admitting it as a State, it had jurisdiction to the Washington shore, and proceeded to arrest Washington men who were fishing in what was the open season according to Washington law but the closed season under Oregon law.

In June, 1908, the voters of the State of Oregon had presented for their consideration two bills radically affecting the waters of Columbia River. One proposed closing the river east of the mouth of the Sandy River against all fishing of any kind except with hook and line, and was originated by gill-net fishermen of the lower river for the purpose of eliminating fish wheels in the upper waters. This bill was the first presented to the people, and when it appeared the upriver men retaliated by presenting a bill affecting the lower river to such an extent that it practically prohibited the net fishermen from operating.

Very much to the surprise of all concerned both bills were passed and became laws on July 1, to take effect, as provided, on August 25 and September 10, respectively. The Oregon master fish warden proceeded to enforce both laws, arresting all violators on both sides of the river, irrespective of whether or not they were operating under a Washington or Oregon license, and incidentally did the fisheries a great service by bringing prominently before the public the anomalous condition of affairs which was occasioned by the archaic system under which the fisheries of the Columbia were governed. The State of Washington appealed to the United States courts, which, after argument, issued an injunction preventing the warden from enforcing the laws so far as the Washington fishermen were concerned.

In the meantime the attention of the General Government had been drawn to the apparently irreconcilable conflict between the two States, and fearing that in the mêlée the interests of the fisheries would be lost sight of, President Roosevelt, in a message to Congress, after reciting briefly the lack of harmony in jurisdiction by the States, recommended that the General Government take over the control of the fisheries of the Columbia, as well as other interstate rivers.

This had the effect of bringing matters to a head, and negotiations were soon in progress looking to the preparation of a treaty between the two States by which uniform laws would be adopted, and thus each State have concurrent jurisdiction to the opposite shore of the river. The legislatures each appointed a committee of eight members to confer and frame joint legislation. The two committees met in Seattle, Wash., early in 1909, and agreed upon the following recommendations:

First. A spring closed season from March 1 to May 1.

Second. A fall closed season from August 25 to September 10.

Third. A Sunday closed season from 8 p. m. Saturday of each week to 6 p. m. the Sunday following between the 1st day of May and the 25th day of August.

Fourth. We suggest the mutual recognition by each State of the licenses issued to floating gear by the other State.

Fifth. That the State of Oregon repeal chapter 89 of the session laws of Oregon for the year 1907, relative to the operation of purse seines and other like gear on the Columbia River.

Sixth. We recommend the enactment of similar laws in both States carrying an appropriation of at least \$2,500 in each State and providing for the destruction of seals and sea lions and the granting of a bounty on the same, to be \$2.50 for seals and \$5 for sea lions.

Seventh. We recommend the repeal of both the fish bills passed under the provisions of the initiative and referendum in June, 1907, by the people of the State of Oregon, said bills being designated on the ballot as 318, 319 and 332, 333.

The recommendations were enacted into law by both States, and at the same time the State of Washington in its bill also prohibited fishing for salmon within 3 miles of the mouth of the Columbia between March 1 and May 1 and between August 25 and September 10, or salmon fishing on tributaries of the Columbia, except the Snake, between June 1 and September 15; and also prohibited fishing for salmon by any means save by hook and line in the Kalama, Lewis, Wind, Little White Salmon, Wenatchee, Methow, and Spokane Rivers and in the Columbia River 1 mile below the mouth of any of the rivers named. The agreement was subjected to a rather severe strain, however, when it was discovered that the Oregon Legislature had failed to provide the same closed periods for the tributaries that were enacted for the Columbia, thus leaving the Willamette, Clackamas, Lewis and Clark, and Youngs Rivers and Spikanon Creek open to fishing for 15 days in March and 15 days in April, while the Columbia was closed. The cry of bad faith was at once raised by the Washington fishermen, and for a short time it appeared that the agreement would be broken at the very beginning. The Oregon Board of Fish Commissioners took the matter up, however, and by order closed these streams to all fishing during the times of closed season on the Columbia, and thus restored peace once more.

This agreement continued in force until 1915, when the legislature of each State prepared for a thorough revision of its fishery code. In order to make this revision more effective, committees from both legislatures were appointed and held joint meetings in Portland, where they mutually agreed upon laws covering the fisheries of the Columbia River, and in order to make this agreement more binding the following chapter was inserted in the codes finally adopted:

All laws and regulations now existing, or which may be necessary for regulating, protecting, or preserving fish in the waters of the Columbia River, over which the States of Oregon and Washington have concurrent jurisdiction, or any other waters within either of said States, which would affect said concurrent jurisdiction, shall be made, changed, altered, and amended in whole or in part only with the mutual consent and approbation of both States.

As such an agreement between two States requires the approval of Congress, a bill ratifying the same was introduced in Congress on December 16, 1915, but was not finally ratified until April 1, 1918.

While the compact was pending in Congress, the Washington legislature at its 1917 session made several changes in the existing fisheries law and contended they were effective because the compact agreement was not ratified by Congress until 1918, which then did not take recognition of the new regulations. When the matter came officially before the superior court of Pacific County, Wash., in 1919, the court held that the compact was valid, thus nullifying

laws passed by the State of Washington affecting the Columbia River since 1915, and if this decision stands in the higher courts of both States all laws passed by either legislature since 1915, affecting the Columbia River fisheries, will fail unless they happen to be the same in both States.

WASHINGTON AND BRITISH COLUMBIA.

The conditions which prevail in Puget Sound adjacent to the boundary between Washington and British Columbia have also been the cause of serious anxiety to those interested in the perpetuation of the salmon fisheries. The great schools of sockeye salmon which are on their way from the ocean to the spawning beds in the Fraser River pass through this section, and it is here that the greater part of the fishing is done. The Province of British Columbia and the State of Washington are vitally interested in the preservation of these fish, but, unfortunately, they seem unable to agree upon any definite policy with regard to their conservation, although it would appear to the unprejudiced observer that it ought to be possible to find some common ground upon which they could agree.

This condition of affairs on Puget Sound and similar conditions in other boundary waters led the General Government to take up the matter, and on April 11, 1908, a convention was concluded between this country and Great Britain for the protection and preservation of the food fishes in international boundary waters of the United States and Canada. Both Governments appointed international commissioners.—Dr. David Starr Jordan for the United States and S. T. Bastedo (who was succeeded later by Prof. Edward Ernest Prince) for Canada—whose duty it was to investigate conditions prevailing in these waters and to recommend a system of uniform and common international regulations. After an exhaustive investigation the commissioners submitted recommendations, which included the following affecting the boundary waters dividing the State of Washington and the Province of British Columbia, these waters being defined as the Strait of Juan de Fuca, and those parts of Washington Sound, the Gulf of Georgia, and Puget Sound lying between the parallels of 48° 10' and 49° 20':

GENERAL REGULATIONS.

3. *Disposition of prohibited catch.*—In case any fish is unintentionally captured contrary to the prohibitions or restrictions contained in any of the following regulations, such fish shall, if possible, be immediately returned alive and uninjured to the water.

4. *Dynamite, poisonous substances, etc.*—No person shall place or use quicklime, dynamite, explosive, or poisonous substances, or electric device in treaty waters for the purpose of capturing or killing fish.

5. *Pollution of waters.*—No person shall place or pass, or allow to pass, into treaty waters any substance offensive to fishers, injurious to fish life, or destructive to fish fry or to the food of fish fry, unless permitted so to do under any law passed by the legislative authority having jurisdiction.

No person shall deposit dead fish, fish offal, or gurry in treaty waters, or on ice formed thereon, except in gurry grounds established by the duly constituted authorities.

6. *Capture of fishes for propagation or for scientific purposes.*—Nothing contained in these regulations shall prohibit or interfere with the taking of any fishes at any time for propagation or hatchery purposes, and obtaining at any time or by any method specimens of fishes for scientific purposes under authority granted for Canadian treaty waters by the duly constituted authorities in Canada and for United States treaty waters by the duly constituted authorities in the United States.

12. *Capture of immature salmon prohibited.*—No salmon or steelhead of less than pounds in weight shall be fished for, killed, or captured in treaty waters.

13. *Salmon weirs, etc., above tidal limits prohibited.*—No salmon and no steelhead shall be fished for, killed, or captured by means of a net of any sort, any weir or any fish wheel, above tidal limits in any river in treaty waters.

14. *Close season for sturgeon.*—During the term of four years next following the date of the promulgation of these regulations no sturgeon shall be fished for, killed, or captured in treaty waters.

15. *Capture of fish for fertilizer or oil prohibited.*—Fishes useful for human food shall not be fished for, killed, or captured in treaty waters for use in the manufacture of fertilizer, or of oil other than oil for food or medicinal purposes.

16. *Naked hooks and spears prohibited.*—No spear, grappling hook, or naked hook, and no artificial bait with more than three hooks, or more than one burr of three hooks attached thereto, shall be used for the capture of fish in treaty waters. This regulation shall not prohibit the use of a gaff in hook-and-line fishing.

17. *Torching prohibited.*—No torch, flambeau, or other artificial light shall be used as a lure for fish in treaty waters.

The following regulations relate specifically to the waters named:

STRAIT OF JUAN DE FUCA AND ADJACENT WATERS.

The following regulations (62 to 66, inclusive) shall apply to the Strait of Juan de Fuca, those parts of Washington Sound, the Gulf of Georgia, and Puget Sound lying between the parallels of 48° 10' and 49° 20' north latitude:

62. *Close season for salmon.*—From August 25 to September 15 in each year, both days inclusive, no salmon or steelhead shall be fished for, killed, or captured for commercial purposes in these treaty waters; provided, however, that in the waters to the westward of a line drawn southward from Gonzales Point to the shore of the State of Washington silver salmon, or coho salmon, may be fished for, killed, or captured from September 1 to September 15 in each year, both days inclusive.

63. *Weekly close season for salmon and steelhead.*—From 6 o'clock Saturday morning to 6 o'clock on the Monday morning next succeeding, no salmon or steelhead shall be fished for, killed, or captured in these treaty waters.

It is, however, provided that in the waters to the westward of a line drawn southward from Gonzales Point to the shore of the State of Washington the weekly close season shall begin 12 hours earlier, and shall end 12 hours earlier.

64. *Construction of pound nets.*—All pound nets or other stationary appliances for the capture of salmon or steelhead shall be so constructed that no fish whatever shall be taken during the weekly close season. The erection or addition to the pound net of a jigger is prohibited.

65. *Location of pound nets.*—All pound nets shall be limited to a length of 2,500 feet, with an end passageway of at least 600 feet between one pound net and the next in a linear series, such distance being measured in continuation of the line of direction of the leader of such net, and a lateral passageway of at least 2,400 feet between one pound net and the next.

On and after January 1, 1911, the mesh in pound nets shall be 4 inches in extension in the leader and not less than 3 inches in other parts of the net.

66. *Nets other than pound nets.*—No purse net shall be used within 3 miles of the mouth of any river and no seine within 1 mile of the mouth of any river in these treaty waters.

No gill net of more than 900 feet in length or of a greater depth than 60 meshes shall be used in these treaty waters.

The effort to enact these regulations into law by our Congress met with decided objections not only on the part of the Puget Sound operators, but also from operators in other waters affected, with the result that the bill was shelved and never acted upon finally. After waiting a while to see if any action would be taken by our Government, Canada finally repealed the act in which it had accepted the regulations.

DECREASE IN SOCKEYE SALMON RUN.

In 1913 the matter of the Frazer River-Puget Sound sockeye salmon run came prominently to the fore through a rock slide in Hell Gate

Canyon, on the Fraser River, caused by blasting operations of a construction gang building a railroad through there. This slide, it was asserted, cut off the greater part of the run to the upper river, and, it was feared, would have a very serious effect on future runs. By the time the run of 1914 arrived the greater part of the débris had been removed from the canyon, and the fish, it was alleged, could once more pass up. Reports of persons who visited these spawning grounds in 1913 and subsequent years were to the effect that but few spawners, as compared with earlier years, were to be found on them.

That the subsequent decrease in the runs was not to be attributed solely to the rock slide in Hell Gate canyon is plainly evident by a glance at the pack figures in this area before and subsequent to 1913. The following statement shows the combined sockeye packs of the American and Canadian packers operating on the run going to the Fraser River:

| | Cases. | | Cases. |
|-----------|-------------|-----------|-----------|
| 1909..... | a 1,590,555 | 1915..... | 155,714 |
| 1910..... | 384,869 | 1916..... | 105,870 |
| 1911..... | 189,767 | 1917..... | a 559,732 |
| 1912..... | 307,775 | 1918..... | 70,420 |
| 1913..... | a 2,401,488 | 1919..... | 98,409 |
| 1914..... | 534,434 | | |

Aside from the damage caused to the "big year" run by the rock slide, there can be only one explanation of such a progressive decline in the pack, and that is excessive fishing. The fishermen of both countries are to blame for this. On the American side traps, purse seines, and, in a slight degree, gill nets, have taken a heavy toll of the fish as they passed through our waters. After some had safely run this gantlet they met thousands of gill nets operated by Canadian fishermen in and around the mouth of the Fraser River and in the lower reaches of same, and it is a wonder that any of the schools ever got to the spawning beds. Several abortive attempts have been made by the authorities of Canada and British Columbia on the one side and the State of Washington on the other to arrive at some equitable method for protecting this sockeye run. The former especially have professed an earnest desire to do something along this line, and there is no reason to doubt their sincerity. On the American side a few people, and among these a few of the more intelligent canners, pleaded for the enactment of laws that would adequately protect the salmon, but they were overborne by the great bulk of the packers and fishermen who, disregarding all the warnings and teachings of experience, insisted upon going ruthlessly forward with the slaughter, and when reproached with their shortsightedness clamored for the establishment of more salmon hatcheries, as though the latter could accomplish the miracle of increasing the supply of fry from a steadily decreasing supply of eggs.

That this wanton destruction of one of our greatest natural resources should have been permitted to continue unchecked by the people of Washington and British Columbia is a most surprising thing, and indicates either a most remarkable ignorance of the condition, which should have been patent to everybody, or a criminal apathy.

* The big year, which comes every fourth year.

AMERICAN-CANADIAN FISHERIES CONFERENCE.

In 1917 a joint commission, known as the American-Canadian Fisheries Conference, was appointed to take evidence and see if it were possible to compose the fishery disputes which had affected the good relations of the two countries for over 150 years. The commission was composed, for America, of William C. Redfield, Secretary of Commerce; Edwin F. Sweet, assistant Secretary of Commerce; and Dr. Hugh M. Smith, Commissioner of Fisheries; and for Canada, of J. Douglas Hazen, Chief Justice of New Brunswick, who had been for six years Minister of Marine and Fisheries for Canada; George G. Desbarats, deputy Minister Naval Service; and William A. Found, Superintendent of Fisheries.

Hearings were held on the Atlantic coast in 1917 and on the Pacific coast in 1918, and in 1919 the commission agreed upon and presented to their respective Governments several treaties concerning these matters, the only one of special interest here being the treaty covering the sockeye fisheries of the Fraser River-Puget Sound, which was signed on September 2, 1919. Owing to its importance this treaty is reproduced entire below:

CONVENTION FOR THE PROTECTION, PRESERVATION, AND PROPAGATION OF SALMON.

The United States of America, and His Majesty George V, of the United Kingdom of Great Britain and Ireland, and of the British Dominions beyond the Seas, King, Emperor of India, equally recognizing the desirability of uniform and effective measures for the protection, preservation, and propagation of the salmon fisheries in the waters contiguous to the United States and the Dominion of Canada, and in the Fraser River System, have resolved to conclude a convention for this purpose, and have named as their Plenipotentiaries:

The President of the United States of America, the Honorable Robert Lansing, Secretary of State of the United States of America, and

His Britannic Majesty, the Honorable Ronald Lindsay, his charge d'affaires at Washington, and the Honorable Sir John Douglas Hazen, a Knight Commander of the Most Distinguished Order of St. Michael and St. George, Chief Justice of New Brunswick, and a member of his Privy Council for Canada.

Who, having exhibited their full powers, found to be in due form, have agreed to and signed the following articles:

ARTICLE I.

The times, seasons, and methods of sockeye-salmon fishing in the waters specified in Article III of this Convention, and the nets, engines, gear, apparatus, and appliances which may be used therein, shall be limited to those which are specified in the regulations appended hereto, and/or which may be specified in revised, modified, or substituted regulations provided for in Article VI and promulgated in accordance with the terms of Article II.

ARTICLE II.

The High Contracting Parties engage to put into operation and enforce by legislative and executive action, with as little delay as possible, the provisions of this convention and said regulations, and the date when the said regulations shall be put into operation, shall be fixed by concurrent proclamations of the President of the United States and of the Governor General of the Dominion of Canada in Council. Each of the High Contracting Parties may, by appropriate legislation, provide for the trial, conviction, and punishment within its jurisdiction of any person found there who has contravened any of the provisions of this convention, and/or said regulations within the jurisdiction of the other High Contracting Party, and who has not been punished for such offence within the latter jurisdiction.

ARTICLE III.

It is agreed that the provisions of this convention and of said regulations shall apply to the waters included within the following boundaries:

Beginning at Carmanagh Lighthouse on the southwest coast of Vancouver Island, thence in a straight line to a point three marine miles due west astronomic from Tatoosh Lighthouse, Washington, thence to said Tatoosh Lighthouse, thence to the nearest point of Cape Flattery, thence following the southerly shore of Juan de Fuca Strait to Point Wilson, on Quimper Peninsula, thence in a straight line to Point Partridge on Whidbey Island, thence following the western shore of the said Whidbey Island, to the entrance to Deception Pass, thence across said entrance to the southern side of Reservation Bay, on Fidalgo Island, thence following the western and northern shore line of the said Fidalgo Island to Swinomish Slough, crossing the said Swinomish Slough in line with the track of the Great Northern Railway, thence northerly following the shore line of the mainland to Point Grey at the southern entrance to Burrard Inlet, British Columbia, thence in a straight line to the southern end of Gabriola Island, thence to the southern side of the entrance to Boat Harbor, Vancouver Island, thence following the eastern and southern shores of the said Vancouver Island to the starting point at Carmanagh Lighthouse, as shown on the United States Coast and Geodetic Survey Chart No. 6300, as corrected to July 20, 1918, and also the Fraser River and its tributaries.

The High Contracting Parties engage to have prepared, as soon as practicable, charts of the waters described in this article, with the international boundary line indicated thereon; and to establish such buoys and marks for the purposes of this convention as may be recommended by the commission referred to in Article IV.

ARTICLE IV.

The High Contracting Parties agree to appoint, within two months after the exchange of ratifications of this convention, a commission to be known as the International Fisheries Commission, consisting of four persons, two to be named by each party. This commission shall continue to exist so long as this convention shall be in force. Each party shall have the power to fill, and shall fill, from time to time, any vacancy which may occur in its representation on the commission. Each party shall pay its own commissioners, and any joint expenses shall be paid by the two High Contracting Parties in equal moieties.

ARTICLE V.

The International Fisheries Commission shall conduct investigations into the life history of the salmon, hatchery methods, spawning-ground conditions, and other related matters, and shall observe the operation of the said regulations appended hereto, and shall recommend to their respective Governments any modifications of, additions to, or substitutions for the appended regulations which may be found desirable.

ARTICLE VI.

The regulations appended to this convention shall remain in force for a period of eight years from the date of their promulgation, as provided in Article II, and thereafter until one year from the date when either of the High Contracting Parties shall give notice to the other of its desire for their revision, or until the termination of this convention, whichever shall first occur. Immediately upon such notice being given, the International Fisheries Commission shall proceed to make a revision of said regulations, which revised regulations shall be incorporated in a special agreement between the High Contracting Parties. It is understood that such special agreement shall on the part of the United States be made by the President of the United States, by and with the advice and consent of the Senate thereof. Such special agreement shall be binding only when confirmed by the two Governments by an exchange of notes. Such special agreement shall be promulgated as provided in Article II hereof, and shall remain in force for a period of five years and thereafter until one year from the date when a further notice of revision is given as above provided in this article, or until the termination of this convention, whichever shall first occur.

It shall, however, at any time, be in the power of the High Contracting Parties by special agreement upon the recommendation of the International Fisheries Commission, to make modifications of, additions to, or substitutions for any of the regulations in force, and (or) to make the provisions of this convention, and any regulations pro-

mulgated in accordance with the terms thereof, operative in the waters specified in Article III of this convention, as to any or all of the other species of salmon, including steelhead. It is understood that such special agreement shall on the part of the United States be made by the President of the United States, by and with the advice and consent of the Senate thereof. Such special agreement shall be binding only when confirmed by the two Governments by an exchange of notes. Such special agreement shall be promulgated as provided in Article II hereof.

ARTICLE VII.

This convention shall remain in force for a period of fifteen years, and thereafter until two years from the date when either of the High Contracting Parties shall give notice to the other of its desire to terminate this convention.

ARTICLE VIII.

The present convention shall be duly ratified by the President of the United States, by and with the advice and consent of the Senate thereof, and by His Britannic Majesty, and the ratifications shall be exchanged at Washington as soon as practicable.

IN FAITH WHEREOF, the respective plenipotentiaries have signed the present convention in duplicate and thereunto affixed their seals.

Done at the City of Washington this second day of September, in the year one thousand nine hundred and nineteen.

ROBERT LANSING, (Seal)
R. C. LINDSAY, (Seal)
J. D. HAZEN. (Seal)

APPENDIX.

INTERNATIONAL REGULATIONS FOR THE PROTECTION AND PRESERVATION OF THE SOCK-EYE SALMON FISHERIES OF THE FRASER RIVER SYSTEM.

SECTION 1.

The following regulations shall apply to the waters described in Article III of the convention of September 2, 1919, between the United States and Great Britain, to which these regulations are appended, to-wit:

(Here is inserted the description of the waters affected, as already set forth in Article III above.)

SECTION 2.

DEFINITIONS.

"Drift net" shall mean a floating gill net that is neither anchored nor staked, but that floats freely with the tide or current.

"Trap net" shall include a pound net.

"Commission" shall mean the International Fisheries Commission appointed under the convention to which these regulations are appended.

"Treaty waters" shall mean all waters described in Article III of the convention to which these regulations are appended.

SECTION 3.

(a) Fishing for sockeye salmon in the treaty waters within the territorial limits of the State of Washington, shall not be permissible except under license from such state, and in the treaty waters of Canada except under license under the provisions of the fisheries act of Canada.

(b) No greater number of licenses for any class of fishing appliance shall be authorized in any year in the treaty waters within the territorial limits of the State of Washington than were issued for such class for the season of 1918, up to August 31st, inclusive thereof, and in the treaty waters of Canada the number of gill nets that may be licensed in any year shall not exceed 1,800.

(c) No license shall be granted to any person or partnership in the State of Washington unless such person or each member of such partnership shall be an American citizen, resident in said State, and no license shall be granted to any joint-stock company or corporation in said State, unless the officers, directors and the holders of a majority of the stock thereof, are American citizens, or unless it is authorized to do business in the said State; and no license shall be granted to any person, company or firm in the Province of British Columbia unless such person is a British subject

resident in the said Province, or unless such company or firm is a Canadian company or firm, or is authorized by the Provincial Government to do business in the said Province of British Columbia.

(d) No one other than a British subject who owns or leases land on either side of the Fraser River above New Westminster Bridge, and who actually permanently resides on, and is cultivating such land, shall be eligible for a license to fish for sockeye salmon between New Westminster Bridge and Mission Bridge, but fishing under such license shall not be carried on below New Westminster Bridge.

SECTION 4.

The use of nets other than drift nets, purse seines, and trap nets shall not be permitted in treaty waters for the capture of sockeye salmon.

SECTION 5.

No net fishing or fishing of any kind, other than with hook and line, except for hatchery purposes, or scientific purposes, shall be permissible in the Fraser River above the down river side of Mission Bridge.

SECTION 6.

During the years 1920 to 1927, both years inclusive, no one shall fish for, catch or kill any salmon from the 20th day of July to the 31st day of July in each year, both days inclusive; and during this close time, no nets or appliances of any kind that will capture salmon may be used in these treaty waters. *Provided, however,* That salmon fishing for hatchery or scientific purposes may be authorized during this period.

SECTION 7.

The weekly close time for salmon fishing shall be from six o'clock a. m. Saturday, to six o'clock p. m. Sunday, in Canadian waters excepting in that portion of the Fraser River between New Westminster Bridge and Mission Bridge, where the weekly close time shall be from six o'clock a. m. Saturday to six o'clock p. m. on the following Monday, and in the treaty waters of the United States from Friday at four o'clock p. m. to Sunday at four o'clock a. m. and during this close time no salmon fishing of any kind other than for hatchery or scientific purposes shall be permissible, and during the full period of each weekly close time or annual close season, each trap net shall be closed by an apron across the outer entrance to the heart of the trap, which apron shall extend from the surface to the bottom of the water and shall be securely connected to the piles on either side of the heart of the trap net, fastened by rings not more than two feet apart on tant wires stretched from the top to the bottom of the piles, and such apron, or the appliance by which it is raised and lowered, shall be provided with a signal or flag, which shall disclose whether the trap net is closed, and which shall be of the form and character approved by the commission: *Provided,* that in addition to the foregoing requirement, such trap net shall be equipped with a V-shaped opening, to the satisfaction of the commissioner, and in the lead of such trap net next to the entrance to the heart and immediately adjacent to the apron, of at least ten feet in width at the top and extending below the surface at least four feet below low water, which V-shaped opening shall remain open and unobstructed during the full period of each weekly close time or annual close season. For the purposes of assuring full compliance with this regulation, the owner or operator of each trap net shall constantly maintain during the weekly and annual close time a watchman, whose duty it shall be to cause each trap net to be kept closed and the lead to be kept open, as above provided.

SECTION 8.

All salmon trap nets shall be limited to a total length of twenty-five hundred feet, with an end passageway of at least six hundred feet between one trap net and the next in linear series, such distances being measured in continuation of the line of direction of the leader of such trap net, but in no instance shall more than two-thirds of the width of any passageway at any point be closed by trap nets. There shall also be a lateral distance of at least twenty-four hundred feet between one trap net and the next.

SECTION 9.

A salmon purse seine shall not exceed nineteen hundred linear feet in length, including the lead and attachment, measured on the cork line when wet.

SECTION 10.

(a) No purse seine shall be cast or placed in the water for fishing purposes within twenty-four hundred feet of any trap net.

(b) The use of purse seines for the capture of sockeye salmon shall be confined to the treaty waters southward and westward of a straight line drawn from the lighthouse on Trial Island, British Columbia, to the northwest point of Whidbey Island, State of Washington.

SECTION 11.

A salmon drift net shall not exceed nine hundred linear feet in length, and the vertical breadth thereof shall not exceed sixty meshes, and the size of the mesh shall not be less than five and three-fourths inches, extension measure, when in use.

Had such a treaty been adopted and rigidly enforced 10 or 12 years ago, it might have had a beneficial effect on the Fraser River-Puget Sound sockeye run, but the destruction of the run has progressed to such an alarming extent during the past 7 years that only a total cessation of all fishing for sockeyes in this section for a term of years could have the slightest beneficial effect. The proposed regulations provide that "during the years 1920 to 1927, both years inclusive, no one shall fish for, catch, or kill any salmon from the 20th day of July to the 31st day of July in each year, both days inclusive; and during this close time no nets or appliances of any kind that will capture salmon may be used in these treaty waters * * *." This closed period runs concurrently on both sides of the line, and while it would have but a very slight effect if the salmon were able to reach the spawning grounds in this short period, it certainly can have none if the Canadian gill netters are enabled to start fishing just about the time the salmon have reached the mouth of the Fraser.

The only hope of rehabilitating the sockeye run—and some well-informed observers have grave doubts whether anything will ever accomplish this desirable result—is to close the waters of Puget Sound through which the sockeyes pass and the Fraser River during the months of July and August or such other period as may be necessary to protect the sockeyes from the time they appear off the capes until they have passed beyond the fishermen on the Fraser River to all salmon fishing for a period of 8 or 12 years. As the sockeyes are 4-year fish—i. e., are born and live in fresh water for about a year, then go to sea, and are not observed again until they return in the fourth year after birth (a small proportion live to 5 years, and a vastly smaller proportion to 6 years), spawn on the breeding grounds of the Fraser and then die—a closed period of less than 4 years could have no appreciable effect, as it would not be a complete cycle in the animal's life, while 8 or 12 years, representing two or three cycles of their life, might possibly have a beneficial effect, although the experiences of the past show clearly that it is much easier to destroy a school of fish than it is to restore a much depleted one.

DECREASE IN HUMPBACK SALMON CATCH.

Another unfortunate condition has developed as a result of excessive fishing in Puget Sound of recent years, and that is the heavy decline in the catch of humpback salmon. These fish are caught in the same apparatus as used for sockeyes.

For many years the humpbacks came in countless numbers, and the fishermen were able to sell but a small part of the catch. Despite

this, they persisted in catching them and many thousands were killed and thrown away during the years when the run appeared in the sound. This ruthless and senseless slaughter finally had its natural result, and about four years ago a heavy decline was observed in the catch of that year, and this decline has steadily increased since, with the result that to-day there are grave doubts as to whether the run can be preserved even in its impaired condition. The only hope is that the prohibition of all salmon fishing during the months of July and August may be adopted, which would prevent fishing for either sockeyes or humpbacks, both of which run during these months.

PACKS BY CANADIAN AND AMERICAN CANNERS.

Many people on both sides of the boundary line have been under the impression that the American fishermen on Puget Sound have been by far the greatest offenders in so far as the quantity of sockeye salmon taken has been concerned, but a table ^a prepared by Mr. J. P. Babcock, assistant to the Commissioner of Fisheries of British Columbia, does not bear this out. Previous to 1891 most of the fishing was done by British Columbia fishermen. The table follows:

| Year. | Canadian waters. | American waters. | Total. | Year. | Canadian waters. | American waters. | Total. |
|-----------|------------------|------------------|---------------|-----------|------------------|------------------|---------------|
| | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> |
| 1891..... | 176,954 | 5,538 | 182,492 | 1907..... | 62,617 | 96,974 | 159,591 |
| 1892..... | 79,715 | 2,954 | 82,669 | 1908..... | 74,574 | 155,218 | 229,792 |
| 1893..... | 457,797 | 47,852 | 505,649 | 1909..... | 555,435 | 1,005,120 | 1,590,555 |
| 1894..... | 363,967 | 41,791 | 405,758 | 1910..... | 150,432 | 234,437 | 384,869 |
| 1895..... | 395,984 | 65,143 | 461,127 | 1911..... | 62,817 | 126,950 | 189,767 |
| 1896..... | 356,984 | 72,979 | 429,963 | 1912..... | 123,879 | 183,896 | 307,775 |
| 1897..... | 860,459 | 312,048 | 1,172,507 | 1913..... | 736,661 | 1,664,827 | 2,401,488 |
| 1898..... | 256,101 | 252,000 | 508,101 | 1914..... | 198,183 | 336,251 | 534,434 |
| 1899..... | 480,485 | 499,646 | 980,131 | 1915..... | 91,130 | 64,584 | 155,714 |
| 1900..... | 229,800 | 228,704 | 458,504 | 1916..... | 27,394 | 78,476 | 105,870 |
| 1901..... | 928,669 | 1,105,096 | 2,033,765 | 1917..... | 118,164 | 411,538 | 569,702 |
| 1902..... | 293,477 | 339,556 | 633,033 | 1918..... | 19,697 | 50,723 | 70,420 |
| 1903..... | 264,809 | 167,211 | 372,020 | 1919..... | 34,063 | 64,346 | 98,409 |
| 1904..... | 72,688 | 123,419 | 196,107 | | | | |
| 1905..... | 837,489 | 847,122 | 1,684,611 | Total.. | 8,493,431 | 8,766,640 | 17,260,071 |
| 1906..... | 183,007 | 182,241 | 365,248 | | | | |

METHODS OF PREPARING SALMON.

CANNING.

EARLY DAYS OF THE INDUSTRY.

In the salmon industry canning is and has been almost from the time of the discovery of a feasible method of so preserving the fish, the principal branch. The first canning of salmon on the Pacific coast was on the Sacramento River in 1864, when G. W. and William Hume and Andrew S. Hapgood, operating under the firm name of Hapgood, Hume & Co., started the work on a scow at Washington, Yolo County, Calif. The Hume brothers, who came from Maine originally, had been fishing for salmon in the Sacramento River for some years before the idea of canning the fish had entered their minds, while Mr. Hapgood had previously been engaged in canning lobsters in Maine, and was induced by the Humes to participate in

^a Fraser River Salmon Situation: A Reclamation Project. By John Pease Babcock. Appendix V, Report, British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1919, p. 3. Victoria, British Columbia, 1920.

order that they might have the benefit of his knowledge of canning methods. The late R. D. Hume, who worked in the original cannery and later became one of the best-known cannerymen on the coast, thus describes the plant and the methods employed:^a

Before the arrival of Mr. Hapgood (from Maine) the Hume brothers had purchased a large scow, on which they proposed to do the canning of salmon, and had added an extension to the cabin 18 by 24 feet in area, to be used as a can-making shop. This had a shed on the side next to the river for holding any cans that might be made in advance of the packing season. A few days after the arrival of Mr. Hapgood (Mar. 23, 1864), the tools and machinery were packed and put in position. Mr. Hapgood made some stovepipe and two or three sheet-iron fire pots, and in a short time was ready for can making. The following list of tools and machinery will show how primitive our facilities were as compared with present methods: 1 screw hand press, 1 set cast-iron top dies, 1 set cast-iron bottom dies, 1 pair squaring shears, 1 pair rotary shears, 1 pair bench shears, 1 pair hand shears or snips, 1 pair 24-inch rolls, 1 anvil (weight 50 pounds), 1 forging hammer, 1 tinner's hammer, 1 set punches for making stovepipe, 1 rivet set, 1 grooving set, 2 iron slabs grooved on one side to mold strips of solder, 1 iron clamp to hold bodies of cans while soldering the seams, 1 triangular piece of cast iron about three-eighths of an inch in thickness and 6 inches in length, with a wooden handle attached to the apex, also used for holding can bodies in place while being seamed.

The process of canning was as follows: The bodies of the cans were first cut to proper size by the squaring shears, a line was then scribed with a gauge about three-sixteenths of an inch from one edge, and they were next formed into cylindrical shape by the rolls. They were then taken to the soldering bench and one edge lapped by the other until the edge met the line that had been scribed and fastened there by being soldered a small part of the length to hold them in place for the further purpose of seaming. They were then placed either in the iron clamp, which had a piece of wood attached to its underside, and held firmly, the clamp being closed by the operation of a treadle, or were slipped on a piece of wood, which was bolted to the bench, while being held in place by the triangular hand seamer, which was pressed down on the lap of the seam by the left hand of the operator. When this had been done a piece of solder, which had been prepared by shaking in a can together with rosin, was placed on the seam and melted and rubbed lengthwise of the seam. After cooling the bodies were ready for the end or bottom, which operation was brought about by first cutting out circular blanks with the rotary shears, and then placing them in the cast-iron die and bringing the handle of the screw press around with a swing with force enough to form up the end or bottom. In this operation there were many difficulties, as the ends or bottoms would many times stick to the upper part of the die and refuse to come off, and finger nails were pretty short in those days. To get the ends out of the lower part of the die was not so bad, as a wooden plunger operated by a treadle knocked them out, but sometimes they were in pretty bad shape. When the bottoms or ends were ready they were slipped on the bodies and the edge of the bottom rolled about in a pan of powdered rosin until the seam was well dusted. A piece of solder similar in size and preparation as used for the side seam was placed in the can. They were then placed on the smooth side of the cast-iron slabs, and the operator, with a hot soldering copper shaped to fit the circle of the can, melted the solder and by turning the can rapidly soldered the full circumference. The output of this can factory was very imperfect, as at least one-half of the seams burst, owing to the lack of experience of the manager or want of good judgment.

When the can making was well underway Mr. Hapgood then turned his attention to getting the apparatus for canning on board the house-boat. This in the cooking department consisted of a kettle made of boiler iron about 36 inches in diameter and 5 feet in depth, set in a brick furnace and fired from underneath. Alongside was a round-bottom, cast-iron pot holding about 60 gallons of water and heated in the same manner. These kettles, with a dozen coolers or circular sheet-iron pans with ropes attached and with holes cut in the bottoms for drainage, a set of 5-inch blocks and tackle, with a sheet-iron fire pot and a scratch awl, completed the bathroom outfit. The can filling and soldering room was furnished with a table through the center, where cutting the salmon in pieces to suit and the filling of the cans was done. On each side of the room there was a bench running the full length, on the end of one of which the cans were placed to receive the pickle, which was used at that time instead of the small quantity of salt that is placed in the cans during the operations of these later days.

^aThe First Salmon Cannery. By R. D. Hume. *Pacific Fisherman*, Vol. II, No. 1, January, 1904, pp. 19-21.

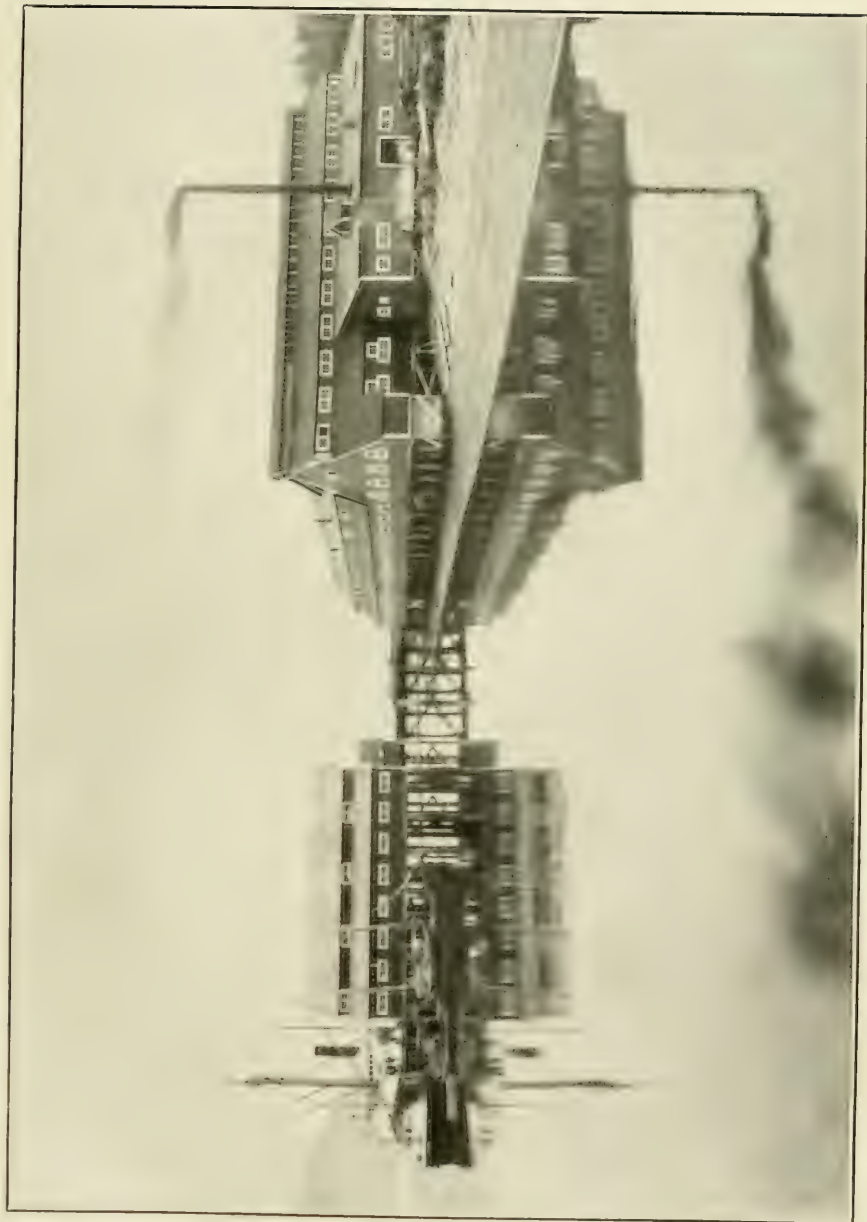


FIG. 26.—SALMON CANNERY AT HOONAH, ALASKA.

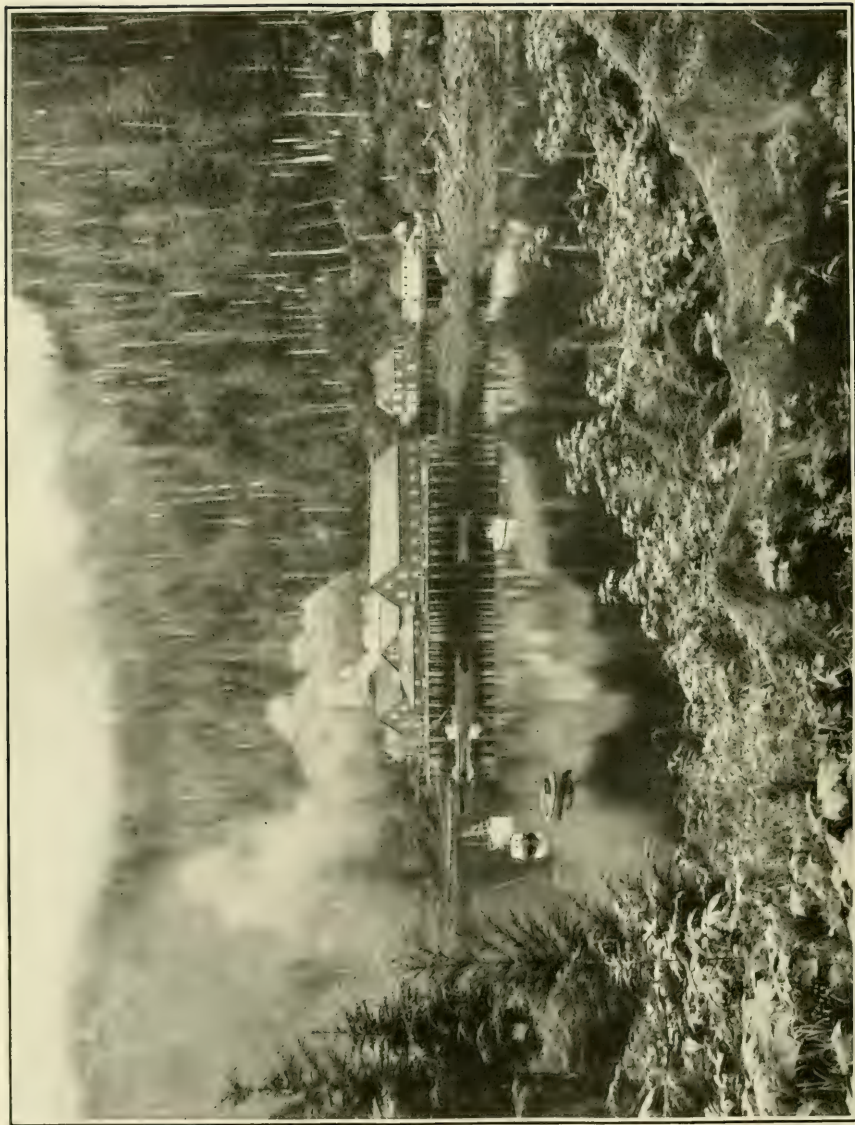


FIG. 27.—SALMON CANNERY AT SANTA ANA, ALASKA.

After the salmon had been cleaned by removing the entrails and washing them outside the covered portion of the scow, they were brought inside and placed on the table, and a man with a butcher knife in one hand and a stick in the other, which had a mark showing the length of the pieces desired, cut gashes in the side of the salmon as a guide and then cut the fish into sections corresponding to the length of the mark on the stick. He then proceeded to cut the sections in pieces to suit the cans. Then three or four operators placed the salmons in the cans and shoved them along the table to where a boy wiped the top edge and passed them along to two others who placed tops which fitted inside of the rim. The cans were then taken in wooden trays to the bench opposite the starting point, which was fitted with four sheet-iron pots, and at the one nearest the entrance to the house on the scow a man put a soldering flux on the top edge, which was made by adding zinc to muriatic acid, and then with a pointed soldering copper and a stick of solder melted the solder until a small portion could be drawn around the groove formed by the edge of the can and the bevel of the top. From there the cans were taken to the other parts of the bench, where two men finished soldering the head in, and then taken to the third man, who soldered, or, as it was called, buttoned, the end of the seam lap. The cooking department or bathroom, as it was called, was separated from the filling and soldering room by a partition. The cans were shoved through a hole in the partition.

At this time the process was a secret. Mr. Hapgood did the cooking and all the work done inside, no one but a member of the firm being allowed to go in. This privacy was continued until the firm moved to the Columbia River, and, the labor becoming too arduous for Mr. Hapgood to perform alone, a boy by the name of Charlie Taylor was taken in as an assistant. * * *

But to return to the original proposition: When the filled cans had been soldered and entered the bathroom they were put in the coolers and lowered into the cast-iron pot, one cooler of cans being cooked at a time. The cooler was lowered into the boiling fresh water until the cans were submerged to within 1 inch of the top ends and left to cook for one hour; then they were hoisted out and the vent holes in the center of the top soldered up, after which they were dumped into the boiler-iron kettle, which held a solution of salt and water of density sufficient to produce, when boiling, a heat of 228° to 230° F. They were cooked in this solution for one hour and then taken out of the kettle with an iron scoop shaped like a dip net, with a wooden handle about 6 feet in length. They were dumped into a tank of water on the other side of the partition which separated the bathroom from the packing room through an opening in the partition, receiving many a bump and bruise in the operation. Then they were washed with soap and rag to remove the dirt and grease, each can being handled separately. When this was done they were piled on the floor of the packing room and in a few days were painted with a mixture of red lead, turpentine, and linseed oil, for at that time buyers would have no canned salmon, no matter how good the quality, unless the cans were painted red.

When packs of 10,000 to 15,000 cases were made in a season only the absolutely essential machinery was used, the rest of the work, such as cutting and cleaning the fish and placing them in the cans, being done by hand. When larger canneries were constructed, especially in Alaska, where labor is expensive and difficult to obtain, the greater part of the workmen having to be brought up from the States, machinery to do as much as possible of the work became absolutely essential. The inventive genius of the country came to the rescue and one by one machines for cutting, sliming, and cleaning the fish, filling the cans, putting the tops on, and washing them were invented and put into use, while automatic weighing machines were produced and extensive improvements and alterations were made in the machines previously in use. There are to-day many large manufacturing establishments which devote all or the greater part of their facilities to furnishing machinery and supplies to this giant branch of the salmon industry.

When salmon canning was in its infancy, a pack of from 150 to 200 cases was considered a good day's work. Now it is not an uncommon occurrence for a cannery to turn out from 2,500 to 4,000 cases in one day, and there are a number which have even greater capacity.

The usual method of figuring the capacity of a salmon cannery is by the number of lines or units employed. The machinery arranged so that the fish pass through all the operations from filling to double seaming is known as a line, and the capacity is based upon the number of these lines in use in the plant.

During the height of the salmon run, a cannery is an exceedingly busy and interesting place, and a description of the methods used at the present time will show the giant strides the industry has made since the days of Hapgood, Hume & Co.

HANDLING THE SALMON.

At convenient spots near the fishing grounds large scows and lighters are anchored and the fishing crews deliver their catches aboard these, the tallyman on each scow keeping a record and giving the crew a receipt. Men fishing near the cannery deliver their catch alongside. Steamers and launches are used to tow out empty scows and bring in those filled. In the old days the fish were pitched by hand into bins on the wharves, but this laborious method has been superseded by the use of an elevator, which extends from a short distance above the top of the wharf to the water's edge, provision being made for raising or lowering the lower end according to the stage of the tide. This elevator is slanting, and is made of an endless chain operating in a shallow trough. About every 2 feet there is attached to the chain a crosspiece of wood. At the top of the elevator are chutes which deliver the fish at various convenient spots on the cutting-room floor.

A recent invention, which is rapidly coming into use, is the unloading scow. This is a scow divided by kid boards into compartments. On the side is an opening which, when not in use, is closed by planks dropped into grooves. The filled scow is run alongside an elevator with a flaring mouth box at the lower end. A chute is placed between the scow, opposite the door, and the elevator, the door opened, and the fish allowed to slide by gravity into the box, then up the elevator to the fish floor. As one compartment is emptied another is attacked by removing the partition boards, and so on until the scow is empty. Should the fish stick, a hose with running water is run a foot or more down into the pile, which loosens the fish and causes them to move freely. By the use of these scows the fish are unloaded in a very short time, with but little labor, and are not marked by pew holes, as under the old method.

If the salmon have been in the scows for from 20 to 24 hours they are used as soon as possible after being delivered at the cannery; otherwise that length of time is usually allowed to elapse, the cannerymen claiming that if not allowed to shrink the fish will be in such condition that when packed much juice will be formed, and light-weight cans will be produced. The danger of canning fish that are too fresh, however, is of minor importance as compared with the tendency in the other direction.

Before dressing the fish a stream of water is kept playing over them in order to remove the dirt and slime, after which men with pews separate the different species into piles.

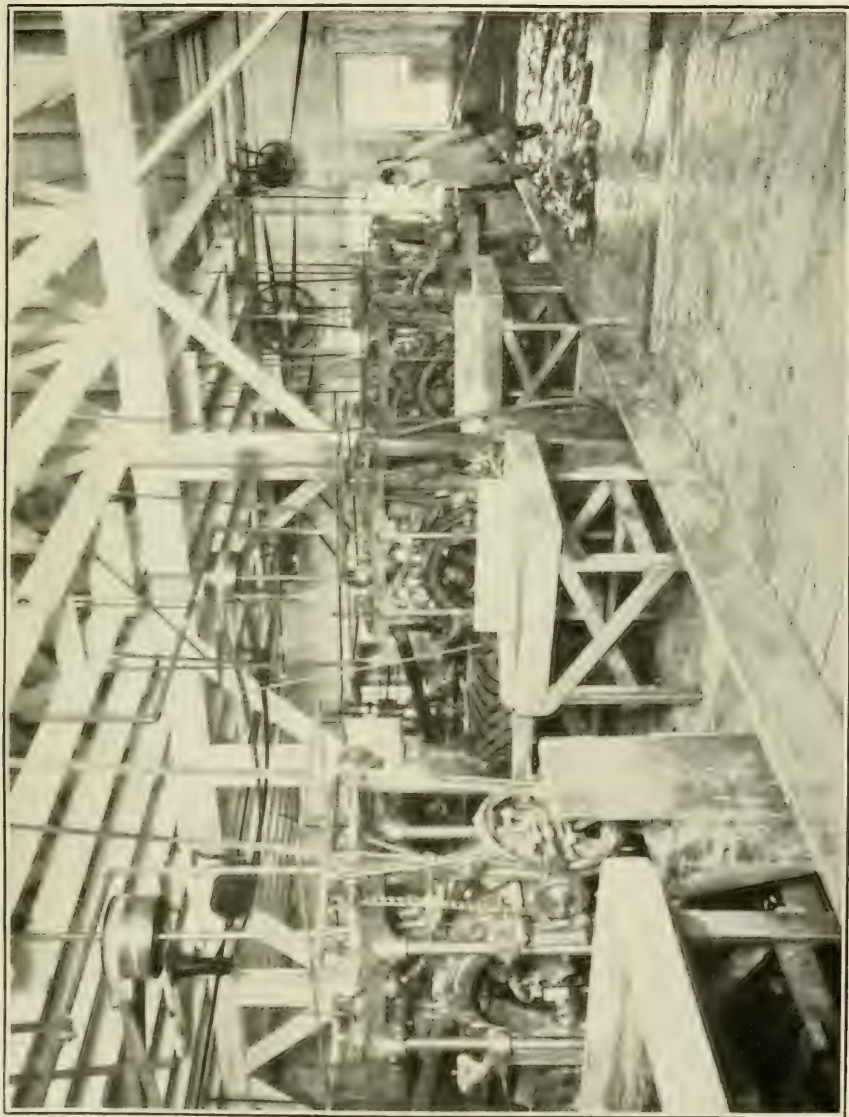


FIG. 28.—A BATTERY OF "IRON CHINKS."



FIG. 29.—CUTTING SALMON INTO PIECES OF A SIZE TO FIT THE CAN.

DRESSING.

A number of the small canneries still use the old hand method of dressing the fish, and in such places the selection of the butchering or dressing gangs is of prime importance. Two men constitute a "butcher's gang," and the number of these gangs is dependent upon the output of the plant. Boys place the fish, with the head out, upon the cutting tables. One man cuts off the heads, and is followed by another who removes the fins, tails, and viscera. The offal is thrown into a chute, whence it passes into the water under the cannery or into a scow moored underneath, while the dressed fish is transferred to a tank of water, to be scaled, washed, and scraped. It is then passed to another tank of water, where it receives a second washing, scraping, and final brushing with a whisklike broom, which removes any offal, blood, and scales that were overlooked in the first washing, after which it is removed to large bins on either side of the cutting machine.

The most useful cannery inventions in recent years have been of machines for doing the work of the dressing gangs. The one commonly known as the "Iron Chink," now in general use in canneries where such machines are employed, was first used in 1903 at Fairhaven (now Bellingham), Wash. It removes the head, tail, and fins and opens and thoroughly cleans the fish ready to cut into pieces for the cans. By the use of these machines the dressing gang is almost entirely done away with, dispensing with 15 to 20 men. This same machine is now so arranged that the fish after dressing are also "slimed;" i. e., the thick mucus covering the skin removed, and the inside of the fish cleaned.

CUTTING.

The usual method of cutting the salmon is by a machine. This is generally a large wooden cylindrical carrier, elliptical in shape, thus having a larger carrying capacity. Ledges or rests on the outside the length of the carrier are wide enough to hold the fish, and are slit in cross section through the ledges and outer casing to receive the gang knives. The latter are circular, fixed on an axle at the proper distances apart, and revolve at the highest point reached by the carrier and independently of the latter. The carrier and gang knives are set in motion, each revolving on its own shaft. As a rest on the carrier comes to a horizontal position, men stationed at the fish bins lay a fish on each ledge as it passes. Thence it is conveyed to the revolving gang knives and, after being divided, passes through on the downward course, sliding off the rest into the filling chute. The knives in these machines are so arranged as to cut the fish transversely in sections the exact length of the cans to be filled.

The rotary cutter shunts the tail pieces to one side, and these are carried by means of a chute to baskets. The tail pieces are generally canned separately. As the tail portion is much smaller, with less meat, it can not be placed in the cans with the middle and head sections without detracting from their value, but if packed under a distinct and separate label, as is now done, there is no reason why the tails should not supply the demand for a cheap grade of fish.

In some of the smaller canneries, especially in those packing flat cans, the gang knives are worked by hand. In this case, the knives are not circular, but elongated or semicircular in shape, tapering at

the outer ends. They are mounted on an axle having a large iron lever at one end, and when this lever is raised the ends of the gang knives are thrown up and back. The fish is then placed in position under them and the lever pulled forward, the knives, with a scimitar-like movement, dividing the fish.

The original method of cutting was by means of a long knife wielded by a Chinaman who stood at a regular butcher's block. Although his strokes were incredibly quick, the rotary cutting machine is a vast improvement over the old way.

SALTING.

Every can of salmon is seasoned with one-fourth of an ounce of salt, which, to insure uniformity, is added by mechanical means. A table is used, in the top of which are holes equal distances apart. On the underside of the top is a sheet-iron plate, with an equal number of holes, which slides in a groove at the sides, and is worked either by a hand or foot lever. Just below is an open space large enough to accommodate a tray holding 36 or 48 cans. A workman stands in front of the table and slides a tray of cans into the open space. He then throws a quantity of salt upon the table and immediately scrapes this off with a thin piece of wood, each hole being filled in the operation, and the salt being prevented from falling through by the iron plate underneath. The lever is then pressed, the iron plate moves forward until the holes in it are directly under the holes in the table top, when the salt drops through into the cans. This operation can be repeated four or five times in a minute. Most canneries now use a small salter attached to the filling machine and this deposits the required amount in the can as it is passing by on its way to be filled.

FILLING THE CANS.

Most canneries now use filling machines for all sizes of cans, although a few, more particularly those packing flat and odd-sized cans, still fill by hand.

The filling machine consists of a chute with a belt to which are attached wire racks about 4 inches apart, set at an angle to prevent the salt from spilling out, into which the salted cans are fed from the floor above and pass into the machine. At the same time the divided sections of salmon pass down another chute into the mouth of what looks like a hand coffee mill. They pass through here down a smaller chute and are forced by two dogs into a receptacle through which the plunger, or filler, passes. Here the plunger comes opposite the open mouth of the empty can, which when it reaches this point is caught by a clasp or hook and held in front of the plunger, which is immediately thrust forward through a chamber filled with salmon, cutting the fish longitudinally and at the same time filling the can. The next movement forces the can out upon a table. When running at full speed, one of these machines will fill about 80 cans a minute.

On being released by the clamp and rolling upon the table they are righted by a workman and pushed onto an endless belt, upon which they pass into the weighing machine. If of the proper weight, they pass through this machine, but if below the required weight the cans are shunted to one side, where workers add the quantity of fish needed, a supply of small bits being kept at hand for this pur-

pose. Generally the cans overrun in weight, frequently as much as 2 or 3 ounces. Occasionally a can is weighed on a small balance scales in order to see that the machine is in perfect adjustment.

After passing the weighing machine any bones and scraps of flesh which may be sticking up out of the can are clipped away by workers armed with scissors.

In the hand method the fillers stand on each side of a long table with a trough running down the middle from end to end. This is filled with the cut pieces of salmon, and the fillers, usually women and children, put large pieces into the cans at first and then smaller pieces to occupy the vacant spaces.

From the weighing machine the cans pass to the clinching machine, which attaches the top of the can loosely to the body in such a way that it allows the air in the can to escape, yet prevents the fish from coming in direct contact with the steam of the exhaust box. Also the water resulting from the condensation of steam, which accumulates in the exhaust box, is kept from entering the can and thus bleaching the flesh.

In many plants the cans are washed by jets of water or steam directed against them in a closed box as they are passing from the clincher to the exhaust box.

The cans then pass into a steam exhauster, consisting in one type of a box about 30 feet in length, in which are three endless-chain belts running side by side. Under and over each belt are steam coils, and under each of the lower coils are single pipes, which through small holes throw jets of live steam upon the coils, creating an intense heat. The cans pass along the first belt, are then transferred to the second belt, on which they return to the entrance of the box, whence they pass to the third belt, and continuing along this to the end pass out to the double seamer, the whole operation occupying from 5 to 15 minutes, preferably 15. One style of exhauster has 10 ovals formed by the pipe, and the cans pass along these from side to side of the exhauster until discharged at the far end. Another type is formed of a long tube through which the cans pass and are heated by perforated steam pipes. Upright exhausters, in which the cans travel along a spiral, are also in use. By this means the contents of the can are heated and the greater part of the air exhausted, which is the object of the first cooking in the retort under the method formerly in general use. In Alaska, where 1-pound tall cans form the bulk of the pack, the cans are exhausted at a temperature from 206° to 212° F., 210° being the favorite.

A recent invention, which the inventor claims will do away with the steam exhaust box, and thus save a large amount of valuable floor space in the canning "line," is the power vacuum pump, known as vacuum exhausting machine, by means of which air is exhausted from the cans, accomplishing the same purpose as the steam exhaust box. Some of these machines have been in active use for several seasons, with most satisfactory results.

Leaving the exhauster the cans pass to the double seamer, which fastens the cover on tightly with a double seam or crimp. It should be stated that no solder is used in attaching the top on the can, the curled flanges of the cover being coated around the outer edge with cement or other sealing fluid to take its place. Solder, however, is used in joining the side seam of the can, this being done when the can

is manufactured. The cans then leave the machine on an endless conveyer, pass through a machine which washes the outside of the cans, and thence to the men who transfer them to the coolers, which are immediately placed upon the trucks and run into the retort for the one cooking they are to receive. By the use of these cans the soldering machine used in the old-style method is done away with. It also does away with the first cooking and the subsequent venting and soldering, a saving both in labor and time consumed.

COOKING.

The processing time varies in each district and sometimes for each species. In Alaska 1-pound tall reds, cohos, chums, and pinks are generally cooked from 90 to 120 minutes, at 12 to 18 pounds pressure and at a temperature of 242° to 248° F. One-pound flats and half-pound cans are generally cooked about 10 minutes less time. Owing to their larger bones, king salmon are generally cooked from 10 to 20 minutes longer than the other species; steelhead trout also.

On Puget Sound 1-pound tall sockeyes, cohos, and pinks are generally cooked for 90 minutes at a pressure of 10 pounds and at a temperature of 240° F. Halves and 1-pound flats are generally cooked at the same temperature but for only 80 minutes. Chum talls are generally cooked for 105 minutes at a pressure of 10 pounds and at a temperature of 240°; while spring or king salmon are cooked for 120 minutes at a pressure of 10 pounds and at a temperature of 240°.

It is the custom at all canneries, no matter what the system, to allow about 5 minutes at the beginning of the cooking to work up the required heat of the retort, and when cooking is completed there is a like period for reducing the temperature and pressure before opening the doors. The cooking times given above are exclusive of the two 5-minute periods noted here.

It should be distinctly understood that the processing times noted are only approximate. The condition of the fish, the weather—whether hot or cold, rainy or dry—etc., all must be taken into account. The canner can not go far astray, however, if he keeps generally within the narrow margins noted above. In the early days much secrecy and mystery was thrown about the cooking, and the work was carried on in a separate room, known as the "bathroom," under lock and key. The first cooking was done in common tubs. The early retorts were made of wood. Later, round iron kettles were substituted, nearly one-half consisting of cover, and round crates were used for holding the cans. At the present time only rectangular horizontal iron or steel retorts are used, and access to these is had by means of miniature railroad tracks.

For many years cannery men believed that the double cooking of salmon was absolutely necessary, but in 1898 F. A. Seufert, at his cannery on the Columbia River, at Seuferts, Oreg., a short distance above The Dalles, discarded this idea, and has since used a one-cooking method. By the new process the cans are tested for leaks after the center hole in the top is soldered up, as before, and are left in the retort 70 minutes at 245° F. and 12 pounds steam pressure. According to its originator, this method saves more than one-half the labor in the bathroom, saves nearly one-half the labor in washing the cans after cooking, and also better retains the color of the fish.

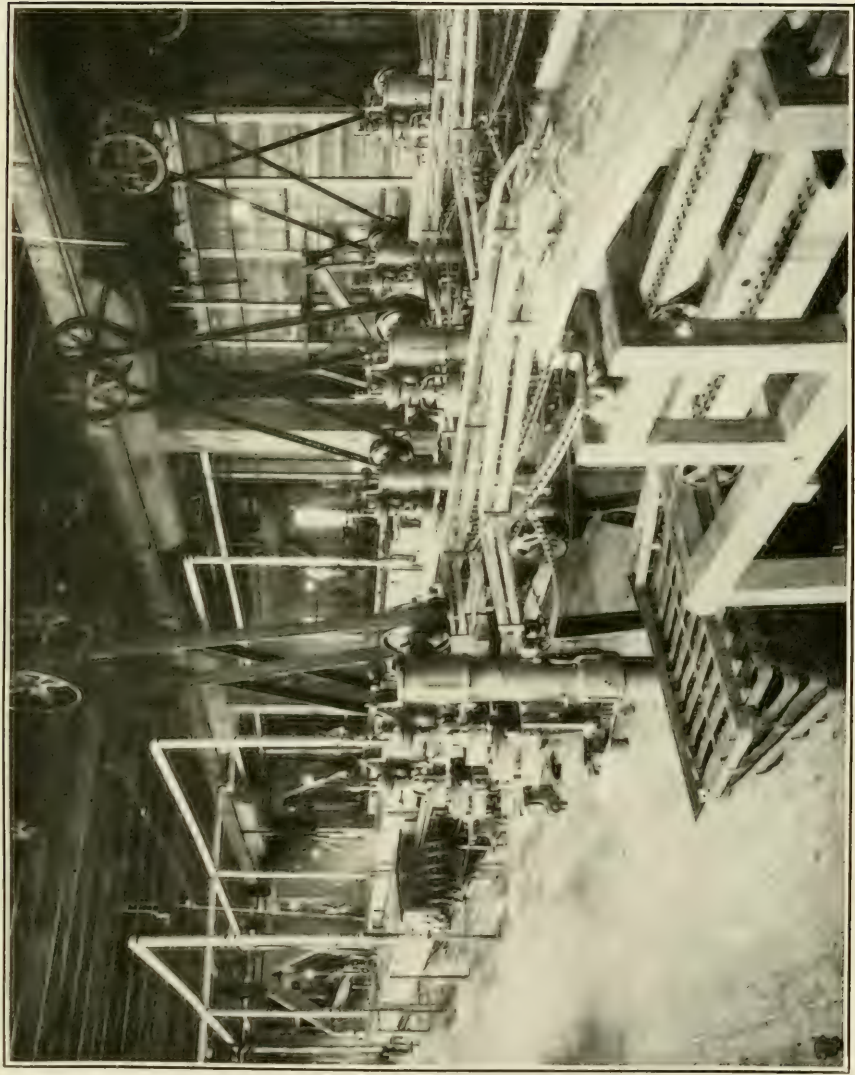


FIG. 30.—EXHAUST BOXES AND THE DOUBLE SEAMERS.

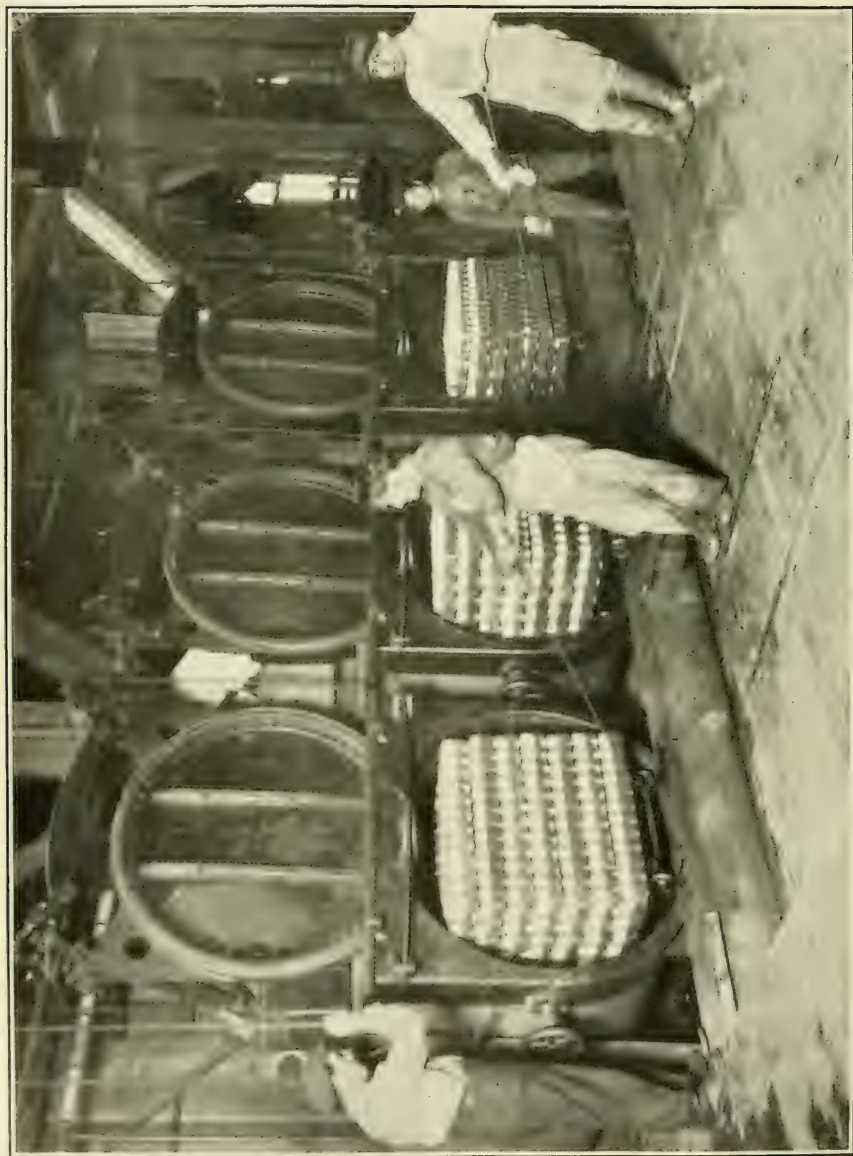


FIG. 31.—COOKING THE SALMON IN RETORTS.

REPAIRING CANS.

Imperfect cans which are discovered after cooking and are repaired at once and whose contents are recooked are still very good, the only difficulty being that by blowing or venting them a second time they lose weight. The above goods usually go in with the regular pack of their kind and are not classed as regular "do-overs." The latter were generally defective cans, which, owing to pressure of other work, could not be repaired until considerable time had elapsed, by which time decomposition had set in. The cans which can not be repaired immediately are now thrown onto the cannery dump.

On coming from the retort the coolers are lowered into a bath of lye, or, as in some canneries, the cans are run through such a bath on an endless belt, which, with the aid of a slight rinsing and a few rubs with a brush over the top, removes from the can all the grease and other material. The belt then passes them into another bath where the lye is washed off in hot fresh water. The cans then go to the cooling room, where a stream of water is played upon them, or during rainy weather are placed out of doors upon the wharf, and there allowed to cool, in order to stop the heat inside the can from continuing to cook the fish. In some canneries the lye bath before cooling is dispensed with, as the earlier washings are supposed to have cleaned the cans.

The top and bottom of the cans contract in cooling, and for several hours a sharp popping noise is heard. Here, as in nearly every process through which they pass, the cans are again tested, this time by tapping the tops with a small piece of iron about 6 inches long, or, sometimes, a 12-penny nail. The sound conveys to the ear of the tester an unmistakable meaning as to the condition of the can, and the faulty cans that escape notice during the other tests are almost invariably found in this one.

LACQUERING.

A common custom in the salmon-canning industry, but one that is not common in the canning of vegetables, fruits, etc., is that of lacquering the cans. This idea of protecting the can on the outside has been followed from the very beginning, for two reasons: (1) That the English market which, at that time especially, absorbed the greater part of these goods insisted on their shipments being finished in this way, and (2) from the fact, as these cannerns speedily found out, that if they did not protect their cans in some way enormous losses through rust would ensue.

The first experiment of this nature was to paint the cans by hand with red paint, treating each singly. Next a composition of logwood extract and alcohol was tried, which, however, did not produce satisfactory results for a very plain reason—the can was dyed instead of being lacquered. The next attempt was to varnish the cans with a japan varnish reduced with alcohol, but this was found to dry too slowly for speedy handling. After extended experimentation the quick-drying brown lacquer of the present time was evolved, which carries asphaltum in the form of an asphalt varnish as its base, this being supplanted in some cases by gilsonite. This lacquer can be procured in either a heavy or light body, is generally reduced with ben-

zene or gasoline, and is applied according to the requirements of the market, which in some localities demands a heavy coating and in others a much lighter finish, the latter giving a rich golden brown color. Some experiments have also been made in using brighter colored lacquers for this work. Several of these, made to give a bright golden, copper, or other color, are extremely attractive in appearance, while at the same time protecting the tin against rust quite as well as the brown.

The industry soon outgrew the hand method of lacquering, and the process which for a number of years was universal in the trade and is still used by some canneries succeeded it. For this there are a number of rectangular box vats about 40 by 80 inches and 18 inches in depth, the number varying with the capacity of the cannery. These are usually lined with galvanized metal and provided with a grid-iron-shaped iron frame, hung from a windlass or other tackle for lifting or lowering from top to bottom of the vat. The cans are loaded on this gridiron, being placed in an inclined position to allow the draining of the lacquer, and are lowered in the vat sufficiently to submerge them in the lacquer with which the vat is charged to a depth of 7 to 10 inches. The loaded gridiron is then raised to the top of the vat and the cans allowed to drain and dry before piling. This method, while being more effective in regard to the volume of work, was still of necessity a very slow and tedious operation. In damp or rainy weather, especially when it is not possible to open warehouse doors and windows, the gas arising from a number of these vats makes effective drying almost impossible.

Another principal objection to this method of lacquering, which applied also to all earlier attempts, was the impossibility of obtaining an even coat of lacquer when the can was allowed to dry in any stationary position. There was also a large waste by evaporation.

Notwithstanding repeated efforts at invention, however, it was not until 1901 that an effective machine for handling this difficult work was put on the market. The apparatus now in use by a number of canneries receives the cans on a revolving wheel fitted with rests for holding them while passing through the lacquer bath. From here they roll upon an endless chain which revolves the cans as they pass through a long box in which a hot blast dries them before they reach the end of the machine. The rotating or rolling motion given to the can after the lacquer bath, preventing the lacquer from draining to and consequently accumulating on any part of its surface, also has the effect of distributing the lacquer evenly and results in a clean and neatly finished can. The air blast facilitates the work of drying to such an extent that it requires only about two minutes after being deposited on the drying bed of the machine for the cans to be ready for handling, while the quantity of cans which can be handled in a day is vastly greater than by the old method.

A few flat and oval cans are not lacquered, but are protected from rust by wrapping in tissue paper, over which the label is placed.

Several of the largest operators have stopped lacquering the sides of the cans, depending upon the label to protect this portion from rust. Enameled ends are used, and, as these are bought from can makers, these operators are thus enabled to get away entirely from the dangers of lacquering.

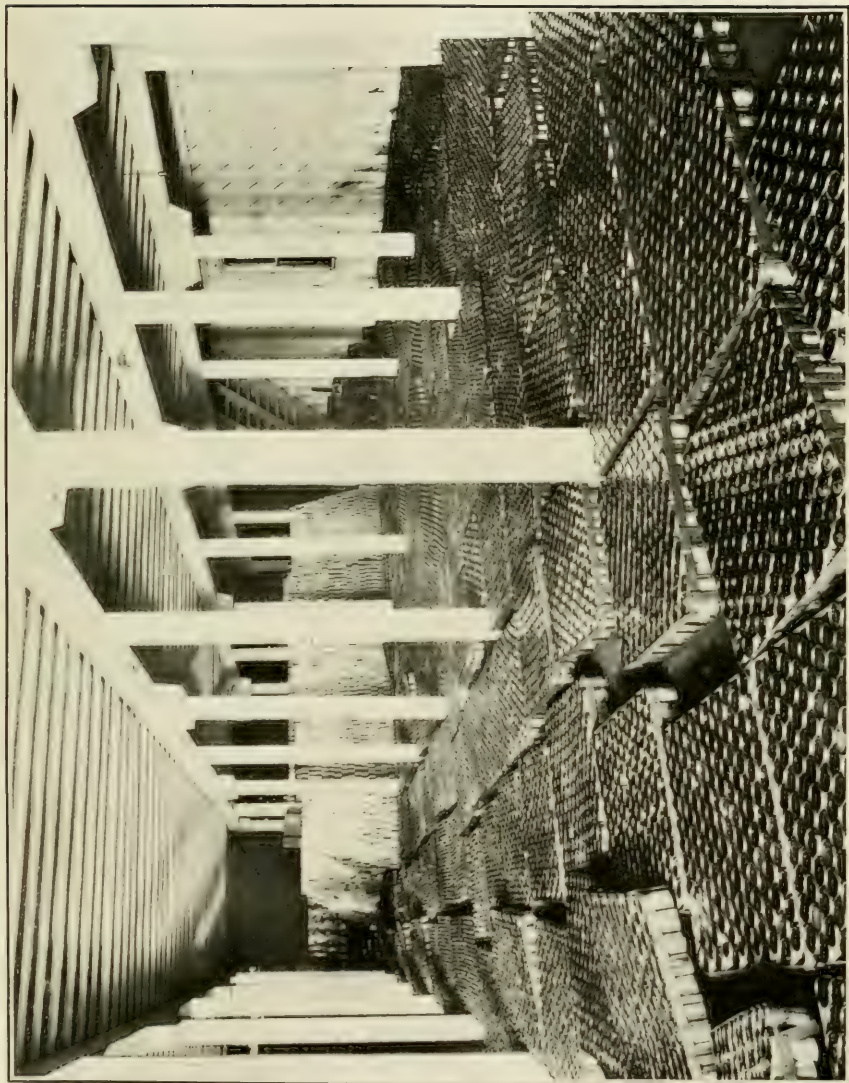


FIG. 32.—COOKED SALMON CANS COOLING.



FIG. 33.—SALMON ON THE FLOOR OF THE FISH HOUSE.



FIG. 34.—SALMON CAN-LABELING MACHINE.

LABELING.

While machines have been made for this purpose, and some of them are in use, the work is usually done by hand. A number of men or women seat themselves about 4 feet apart in front of the pile of cans. Each man has in front of him a package of several hundred labels, and by bunching them on a slant so that successive margins protrude beyond each preceding, he can apply paste to the entire number with one stroke of the brush. A can is placed on the label, is quickly rolled, and the label is on much quicker than one can tell it. Each man places to his right the cans he labels, forming a pile of length and width equal to his unlabeled pile, and when the entire lot has been labeled it has been shifted only about 4 feet. Cans of fancy brands of salmon put up on the Columbia River and in the Puget Sound region are wrapped in colored tissue paper before the label is put on. Cartons similar to those used by the sardine packers would make good containers for fancy brands and would be much cheaper than the present method.

Some of the canners now have their labels lithographed directly on the tin, and the whole covered with a transparent lacquer.

Several attempts have been made to popularize salmon packed in glass and porcelain jars, and while these have met with some favor, it was not sufficient to warrant a continuance of the practice for any length of time. But few are being so packed at the present time.

BRANDS.

A very important feature of the canning industry is the selection of appropriate brands or labels for the various grades of salmon. Each company has a number of these, which it has acquired either by designing them or by absorbing another company which owned them. A well-known brand has a value in itself and sometimes is a very important asset. A company will sometimes market a considerable part of its product in one section, and here, where the consumer has become familiar with the brand and pleased with the contents of the can, he will ask for and accept no other, despite the fact that the latter might be, and probably is, the equal of the product he has been using.

For many years but few salmon canners appreciated the value of a can label, and it has taken some bitter experiences to drive home to the rest that a properly designed label placed upon good goods and the owner protected in its use by the law has real value, just as much as boats, nets, buildings, machinery, or the thousand and one material things required to carry on the business.

A free trade definition of a label would be that it is an artistic representation or intellectual production, stamped directly upon an article of manufacture, or upon a slip or piece of paper or other material, to be attached in any manner to manufactured articles, to bottles, boxes, and packages containing them, to indicate the contents of the package, the name of the manufacturer, or the place of manufacture, the quality and quantity of the goods, directions for use, etc.

Labels are subject to the copyright law and should be registered before use or publication. If not registered, there is no protection in law against infringement. The continued use of a label, however,

will give the person so using a certain proprietary right in it, which can be enforced in a court of equity and may be defended by injunctions, which will generally be granted. Such proceedings are expensive, annoying to a busy man, and at best will protect one only after at least a certain amount of damage has been done, and it is far safer to avoid this by registering the label at the time of issue, which will give one the further advantage in that a description of the character and quality of the article labeled can be set forth, which will, to a certain extent at least, be protected with the label.

The commercial value of a label and name is represented by the more or less general demand for the goods protected by it. In the canned-salmon industry, as in that of other food-packing industries, certain labels, through the good quality of the goods marketed under them and the publicity created for them, have become of very considerable value to the owners. A case in point is the label Royal Crown, owned by the late R. D. Hume. This was one of the earliest brands marketed in England, and some years later a certain Liverpool firm of salmon handlers paid Mr. Hume the sum of \$10,000 for the exclusive right to its use in England.

In designing a label there are several things which should be borne in mind. It should bear an easily remembered name and design; a name difficult of pronunciation should be avoided at all costs. For many years glaring red labels have been popular, but the success met with by those using more subdued and artistic designs and coloring indicates that the public appreciate them more than they do the older and coarser types. The design should be as simple as possible, as experience has demonstrated that a simple form—so simple that it can be fully understood by a mere glance—will gain by regular repetition, while a more complicated design will lose in this process.

A good many now in the business still remember the small label that was used on salmon cans before 1870. Labels about 3 by 5 inches in size, printed in one color, on white or colored newspaper, served merely the purpose of distinguishing cans, telling contents and manufacturer, and were without commercial value. About the year 1870 a few canners commenced to import from the East and Europe full-sized labels, i. e., labels that went all around the can. These were called by some "Pennington" labels, as a firm of that name supplied quite a number of them.

For some years they were used for the best grades only. They were printed in four and five colors, the design showing invariably a number of panels of different shapes and sizes. The lettering was not always plain and sometimes even intentionally irregular and puzzling. The colors were placed side by side, in boldest contrast, without any attempt to harmonize them.

It was soon discovered that the highly colored panels, while striking, lost all effect when massed on the retailer's shelves, and the different brands looked so much alike that the individual designs could not well be remembered by the customer, the only really distinctive feature being the name, and that was generally printed so small and indistinct that it could not be readily seen at a distance.

To remedy these defects, the designers soon reduced the number of panels and subdivisions, increasing meanwhile the size of the remaining ones and filling them with distinctive designs, still colored as simply as before, with no attempt at blending of colors. The back-

ground, at first perfectly plain, commenced to show patterns more or less complicated, and at times quite pretentious, so as to take away from the design proper.

Gradually the panel design disappeared. In place of it some showed one continuous picture on the label, which was very unsatisfactory and soon disappeared, as only a fraction of the picture could be seen at one time. Others had two subdivisions, one showing the name of the brand with its illustrations, occasionally used as a trade-mark, the other showing the article packed in the can, both named and illustrated. Unfortunately, these subdivisions were so large that the roundness of the can prevented one from seeing the picture as a whole, but this was soon remedied by making the subdivisions narrower and filling in between with directions, weight of contents, etc.

From this point on the general plan of labels underwent few changes except that the work, both of the artist and pressman, improved wonderfully, some of the labels now designed and printed being real works of art.

Up to a few years ago one of the most serious evils in the trade was the use of misleading and lying brands. The high-grade product would almost invariably be correctly and fully branded, but "chums" and "pinks" were usually branded as "Fresh salmon," "Ch ice salmon," etc., which would deceive all persons but those well acquainted with the industry. "Do-overs," and very poor fish, were usually marketed under a brand which bore the name of a fictitious company or of no company at all.

The passage of State laws of varying degrees of efficiency governing the branding of salmon helped slightly to remedy this condition of affairs, but it was not until the pure food and drugs act, approved June 30, 1906, was put into force by the Government that any radical improvement was noticeable. At the present time but few misleading brands are in use.

BOXING OR CASING.

A case of salmon generally contains 48 one-pound cans or their equivalent, i. e., 24 two-pound cans or 96 half-pound cans. Some canneries pack their half-pound cans in cases of 48. These cases are usually made of wood and cost from 9 to 11 cents each knocked down.

CAN MAKING.

Some of the canneries in the coast States and Alaska purchase their cans ready-made, but the usual method is to purchase the sheet tin and make up the cans in the canneries. This is especially necessary in Alaska, as it would be impossible to find room on the cannery ships for such a bulk as they would make in addition to the other supplies necessary. Furthermore, the making of cans provides work for a large part of the crew, otherwise unemployed while the rest are getting ready the other necessary paraphernalia. The work is done by machinery and occupies several weeks' time.

Of recent years the objection to the great amount of space occupied by the cans when shipped by freight has been overcome by making the body of the can, pressing it flat, and shipping it in this compact shape along with the ends. At the cannery is a machine for rimming the flattened body into a round shape once more, when the end can be put on with the regular double seamer.

CANNING SMOKED SALMON.

A number of ventures in the line of canning smoked salmon have been made on this coast, but most of the pioneers were not content or able to invest the amount of capital needed and wait the time required to create a demand for such products, and soon quit.

One of the leading British Columbia packers, H. Bell-Irving & Co., some years ago put up in cans some pink salmon which had been treated to an artificial smoke in a vat, and these are said to have made a favorable impression in Australia. Another canner operating on the Fraser River smoked pink salmon, and then, cutting them to the proper length, packed them dry in half-pound cans.

In 1908 the Columbia Canning Co. put up at its cannery on Chilkoot Inlet, Alaska, some smoked salmon which had been shaved into thin strips like dried beef. These, called "Flaxamo," were packed in oil and were very good, especially in making sandwiches.

In 1915 two companies began in Seattle the smoking, slicing, and canning of coho and king salmon. These were put up in oblong flat cans of various sizes, similar to sardine cans, $2\frac{1}{4}$, $4\frac{1}{2}$, and $7\frac{1}{2}$ ounces, respectively, while for a special trade a $7\frac{1}{2}$ -pound can was also packed. These fish were cut quite thin, about 40 to 50 slices to the pound, and were packed in hermetically sealed cans with cottonseed oil. The fish were all hard smoked before slicing and canning.

The same companies are also putting up kippered salmon in cans.

Salmon loaf, made by mixing salmon with flour and various other ingredients, thus producing a paste, is also being canned by several packers.

A straight salmon paste, made solely from the flesh of the salmon, and mixed with oil and spices, is being manufactured by one of the leading packers.

HOME CANNING.

At a number of places along the coast it has become the custom for the thrifty housewives to do a little home canning of salmon for winter use when the fish are abundant and cheap, and they find canning salmon as easy as canning vegetables and fruit. The fish are dressed, skinned, and the backbone removed. It is then cut into transverse strips of a size to fit either a pint or a quart glass jar, whichever is to be used. The jars are then filled with the pieces, salted to taste, the rubber ring put on, after which the can cover is put on loosely so that the steam may escape. Strips of thin wood are placed at the bottom of a kettle or wash boiler and the cans set down on them. Enough cold water is then poured into the kettle to bring it up to within about 2 inches of the top of the cans. The kettle is then put on the stove and, after it comes to a boil, note is made of the time, and the cans are cooked from one and one-half to three hours. There seems to be a great variation in the time of cooking on the part of the operators. Some even cook only one hour, but these generally use a preservaline. About three hours seems to be the best time, as the bones are then quite soft. At the end of the cooking period the tops are tightened, the kettle removed from the stove, and the water and cans allowed to cool in the kettle.

Portable retorts and hand doubleseamers are now available for household use, and as a result many are using tin cans as containers. A recent improvement on the double seamer permits of the use of a tin container three times, thus materially reducing the heavy expense for cans.

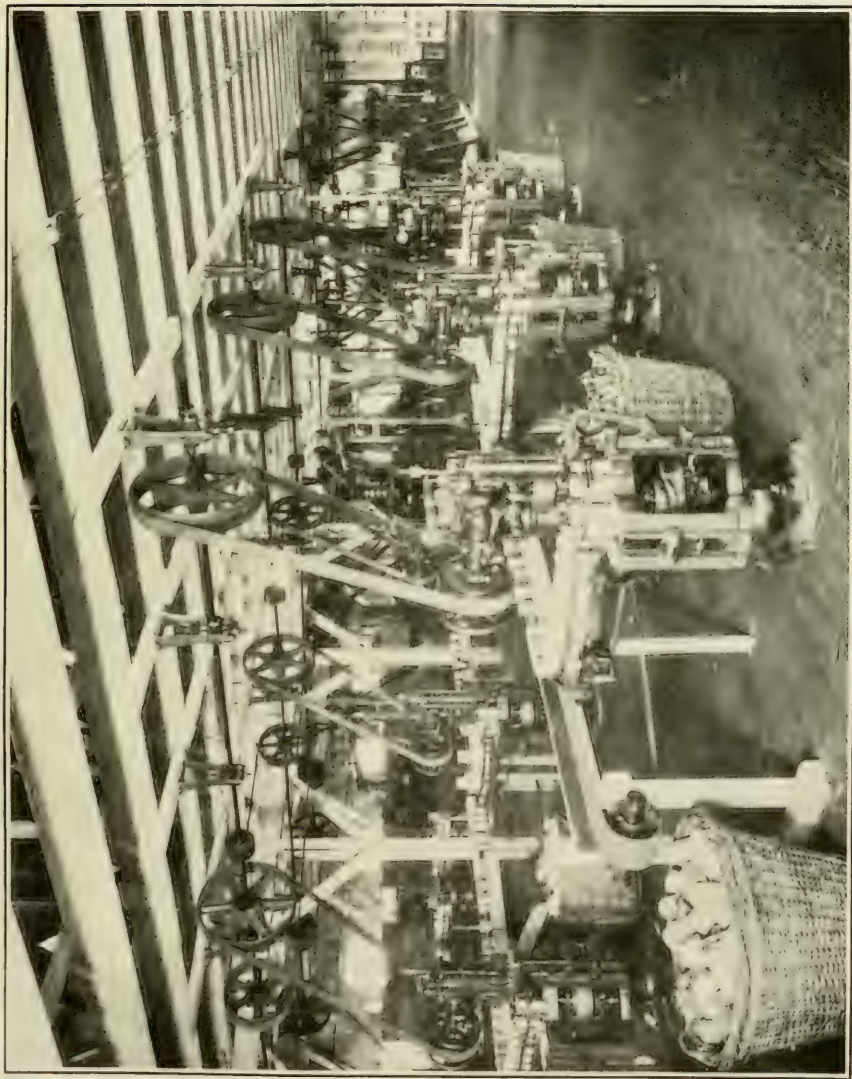


FIG. 35.—MAKING SALMON CANS.

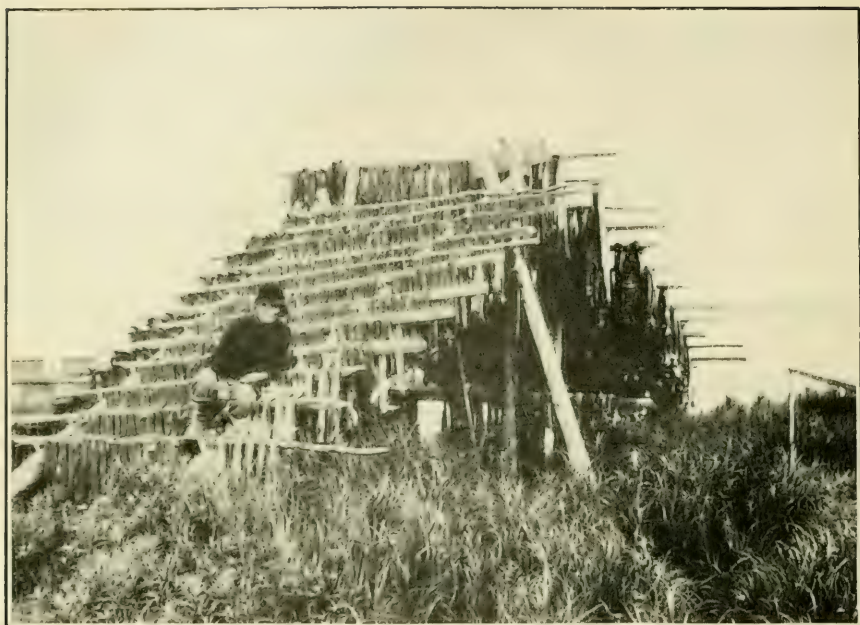


FIG. 36.—AN INDIAN SALMON DRYING RACK, BERING SEA, ALASKA.



FIG. 37.—THE BARONOVICH SALMON SALTERY; THE OLDEST SALTERY IN ALASKA.

INSPECTION OF PLANTS PACKING CANNED SALMON.

For some years there has been a desire on the part of a majority of the salmon canners for some form of inspection of the plants and of the pack made. The widespread suspicion that the salmon pack of 1918 was considerably below standard, which suspicion resulted in heavy monetary loss to the packers, gave a great impetus to this desire. The National Canners' Association, an organization composed of the majority of the canners of the United States, a few years before, at the request of the sardine canners of Maine, organized them into the sardine section of the association, and by an assessment of a small sum per case raised sufficient funds to provide an inspection service to see that the plants were put into and kept in a satisfactory sanitary condition and also to inspect the goods packed and, if they were up to the standards fixed in advance, to affix to the cans suitable certificates attesting this.

At its annual convention in 1919 the association decided to extend a similar service to any other section willing to assess itself to pay the necessary expense. In explanation of its plan the association issued the following circular shortly after the convention had adjourned:

1. This service is installed by the National Canners' Association, with which a direct contract is made by each canner.

2. It runs for a term of three years and is applied in States or local territories where similar conditions are to be met.

3. The cost of the inspection is paid by the canners in the territory named through an assessment which, in the past, has been collected by the can companies with which each canner deals. This cost is added to the can invoice, and is remitted by the can companies to the treasurer of the National Canners' Association each month.

4. In order to meet the preliminary expenses of the inspection before the regular fund becomes available, each canner who signs a contract will pay into the treasury of the National Canners' Association, within 30 days after signing the contract, an assessment of one-half cent per case on his pack of 1918, on the commodities to be inspected. Should the total sum raised during the season be greater than the expenses of inspection during the season, a refund of all or a portion of the one-half cent per case will be made after a small sum is reserved to maintain a consistent surplus.

5. The treasurer of the National Canners' Association distributes this money to the local sections where the money is to be spent.

6. The National Canners' Association has no profit in this inspection--its only requirement being that each canner under inspection is a member of the association, and pays the membership and general dues.

7. A director or supervisor of inspection is appointed by the National Canners' Association who in turn appoints his assistants. The salaries of the director or supervisor and his assistants are fixed by the National Canners' Association which works in harmony with the judgment of the advisory board. The director or supervisor must be a man of superior ability, preferably one with scientific training. He must also be a good executive.

8. The director or supervisor acts in conjunction with the advisory board which may consist of five, seven, or nine members. This advisory board is elected by the canners in the States or Territories covered. The duties of this board are what its name implies, "advisors." In point of actual experience, it is found this advisory board is able to settle all practical disputes and misunderstandings which may arise under this method of inspection. There is always a final appeal to the executive committee of the National Canners' Association.

9. The National Canners' Association does not promise or guarantee to issue certificates of inspection, but in territories where inspection has existed, the certificates have been issued on products which merit the same. It should be distinctly understood, however, that this does not form any part of the contract.

10. The cost in territories where inspection has been applied has been one and one-quarter to two cents per case. It is impossible to advise in advance definitely what the cost will be, as the local conditions differ. It should be borne in mind that there must always be a sufficient number of inspectors to protect the inspection, and

if cannery are widely scattered, this, as a matter of course, will increase the number numerically—not in proportion to the pack.

11. The inspection covers sanitation in plants, quarters for employees, and sanitation of the product. It is also proposed, as the work progresses, to apply inspection to the character of the raw product, and grading of the same. This grading on staples will be worked out on recommendation from the advisory board, which will be harmonized so as to give a uniform grade to each product through the entire country.

12. In localities where inspection has been installed, local laboratories purchased and financed by the funds for inspection, have been found most useful. These laboratories furnish prompt facilities for cannery for testing their product and working out manufacturing problems which come up during the activities of the canning season. These laboratories are established and work in harmony with the research laboratories of the National Cannery Association, Washington, D. C.

13. This inspection can well be made the basis of a consistent publicity advertising campaign, should the industry adopt it generally, in time to guarantee its working satisfactorily during the canning season of 1919. The present plan, however, does not include this publicity campaign, as this is a matter which must necessarily be passed upon later by the cannery themselves.

14. Copy of contract with each cannery is herewith inclosed, for information.

On February 17, 1919, the matter of adopting this inspection system was submitted to the salmon cannery of the Pacific coast and accepted by a large majority. A chief inspector and a number of assistants were appointed, who carried on a sanitary inspection of the various canneries during the following summer. It is the intention ultimately to extend this inspection to the pack itself.

INVESTIGATION OF CANNED SALMON INDUSTRY.

In 1917 and 1918 an investigation of the canned salmon industry was made by the Federal Trade Commission and many valuable statistical data were gathered and published.^a

The following table shows, with other data, the average number of fish per case of each grade packed in the different geographical sections.

NUMBER OF FISH CANNED AND PURCHASED, NUMBER OF CASES PACKED, AND AVERAGE NUMBER OF FISH PER CASE. ^b

1916.

| District. | Grade of fish. | Number of companies reporting. | Number of fish canned. | Number of fish purchased. | Percentage of fish canned which were purchased. | Number of cases packed. | Average number of fish per case. |
|-----------------------------------|----------------|--------------------------------|------------------------|---------------------------|---|-------------------------|----------------------------------|
| West Alaska..... | Kings..... | 7 | 111,381 | 27,175 | 24.39 | 26,003 | 4.28 |
| Central Alaska..... | do..... | 6 | 25,483 | 11,602 | 45.52 | 5,854 | 4.35 |
| Southeast Alaska..... | do..... | 20 | 148,286 | 136,597 | 92.12 | 34,344 | 4.31 |
| Puget Sound..... | do..... | 15 | 180,580 | 80,574 | 44.62 | 25,606 | 7.05 |
| Columbia River..... | do..... | 9 | 865,392 | 842,127 | 97.31 | 265,376 | 3.26 |
| Outside rivers ^c | do..... | 7 | 60,656 | 60,143 | 99.15 | 18,607 | 3.25 |
| Totals and averages..... | | 64 | 1,391,778 | 1,158,218 | 83.66 | 375,790 | 3.73 |
| West Alaska..... | Reds..... | 8 | 16,564,413 | 1,017,042 | 6.13 | 1,223,950 | 13.52 |
| Central Alaska..... | do..... | 6 | 1,387,647 | 547,261 | 39.43 | 118,891 | 11.67 |
| Southeast Alaska..... | do..... | 29 | 1,609,978 | 784,503 | 48.70 | 123,767 | 13.00 |
| Puget Sound..... | do..... | 17 | 2,593,240 | 168,584 | 6.50 | 198,205 | 13.04 |
| Columbia River..... | do..... | 8 | 775,382 | 439,900 | 56.73 | 67,334 | 11.52 |
| Outside rivers ^c | do..... | 1 | 59,352 | 59,352 | 100.00 | 4,645 | 12.78 |
| Totals and averages..... | | 69 | 22,990,012 | 3,016,642 | 13.28 | 1,736,792 | 13.24 |

^a Report of the Federal Trade Commission on Canned Foods. Canned salmon. December, 1918. 83 pp. Washington, 1919.

^b Report of the Federal Trade Commission: Op. cit., pp. 15, 16.

^c Coastal streams in Washington, Oregon, and California.

NUMBER OF FISH CANNED AND PURCHASED, NUMBER OF CASES PACKED, AND AVERAGE NUMBER OF FISH PER CASE—Continued.

1916.

| District. | Grade of fish. | Number of companies reporting. | Number of fish canned. | Number of fish purchased. | Percentage of fish canned which were purchased. | Number of cases packed. | Average number of fish per case. |
|-----------------------------------|-----------------|--------------------------------|------------------------|---------------------------|---|-------------------------|----------------------------------|
| West Alaska..... | Medium reds.. | 4 | 394,048 | 46,619 | 11.83 | 36,078 | 10.92 |
| Central Alaska..... | do. | 6 | 305,246 | 131,998 | 43.22 | 37,275 | 8.19 |
| Southeast Alaska..... | do. | 29 | 1,018,014 | 505,937 | 49.67 | 117,422 | 8.69 |
| Puget Sound..... | do. | 17 | 1,099,374 | 677,485 | 61.62 | 110,658 | 9.93 |
| Columbia River..... | do. | 10 | 346,597 | 310,216 | 89.50 | 42,782 | 8.10 |
| Outside rivers ^a | do. | 8 | 349,053 | 349,348 | 100.00 | 34,937 | 9.99 |
| Totals and averages..... | | 74 | 3,512,332 | 2,331,819 | 66.38 | 379,152 | 9.26 |
| West Alaska..... | Pinks..... | 3 | 4,153,353 | 540,248 | 13.00 | 214,482 | 19.36 |
| Central Alaska..... | do. | 6 | 4,102,775 | 1,821,558 | 44.39 | 212,169 | 19.33 |
| Southeast Alaska..... | do. | 27 | 12,296,379 | 4,772,128 | 38.89 | 873,953 | 13.93 |
| Puget Sound..... | do. | 8 | 1,800,875 | 607 | | 70,979 | 25.37 |
| Totals and averages..... | | 44 | 22,323,382 | 7,134,541 | 31.90 | 1,377,583 | 16.19 |
| West Alaska..... | Chums..... | 7 | 1,144,595 | 289,663 | 25.30 | 97,528 | 11.74 |
| Central Alaska..... | do. | 6 | 331,423 | 160,465 | 48.41 | 37,870 | 8.75 |
| Southeast Alaska..... | do. | 28 | 3,661,176 | 2,296,478 | 62.72 | 344,213 | 10.63 |
| Puget Sound..... | do. | 15 | 2,981,678 | 1,887,278 | 63.29 | 387,373 | 7.70 |
| Columbia River..... | do. | 8 | 374,370 | 358,255 | 95.69 | 62,043 | 6.34 |
| Outside rivers ^a | do. | 5 | 110,809 | 106,973 | 96.53 | 16,806 | 6.56 |
| Totals and averages..... | | 69 | 8,604,051 | 5,099,112 | 59.26 | 945,923 | 9.10 |
| Columbia River..... | Steelheads..... | 7 | 163,774 | 102,117 | 98.40 | 16,991 | 6.10 |
| Totals and averages..... | | 7 | 163,774 | 102,117 | 98.40 | 16,991 | 6.10 |

1917.

| | | | | | | | |
|-----------------------------------|------------------|-----|------------|------------|--------|-----------|-------|
| West Alaska..... | Kings..... | 8 | 107,590 | 18,407 | 17.10 | 21,398 | 5.03 |
| Central Alaska..... | do. | 9 | 34,158 | 19,872 | 58.19 | 6,675 | 5.11 |
| Southeast Alaska..... | do. | 22 | 283,643 | 202,693 | 71.46 | 45,674 | 6.21 |
| Puget Sound..... | do. | 18 | 209,360 | 105,731 | 50.54 | 53,485 | 3.91 |
| Columbia River..... | do. | 10 | 959,846 | 643,063 | 6.99 | 273,291 | 3.51 |
| Outside rivers ^a | do. | 9 | 45,378 | 43,468 | 95.75 | 12,940 | 2.30 |
| Totals and averages..... | | 76 | 1,639,975 | 1,033,234 | 63.00 | 413,463 | 3.96 |
| West Alaska..... | Reds..... | 9 | 21,449,913 | 1,192,000 | 5.56 | 1,433,780 | 14.90 |
| Central Alaska..... | do. | 9 | 2,271,989 | 974,653 | 42.89 | 189,921 | 11.96 |
| Southeast Alaska..... | do. | 33 | 1,964,993 | 1,074,658 | 54.95 | 158,582 | 12.03 |
| Puget Sound..... | do. | 27 | 4,731,861 | 1,233,489 | 26.00 | 372,467 | 12.73 |
| Columbia River..... | do. | 7 | 1,213,887 | 688,637 | 56.72 | 98,076 | 12.36 |
| Outside rivers ^a | do. | 2 | 21,868 | 21,868 | 100.00 | 1,769 | 12.36 |
| Totals and averages..... | | 87 | 31,654,511 | 5,185,305 | 16.40 | 2,254,595 | 14.13 |
| West Alaska..... | Medium reds..... | 3 | 145,837 | 18,389 | 12.60 | 13,406 | 10.87 |
| Central Alaska..... | do. | 9 | 238,572 | 141,424 | 59.29 | 30,430 | 7.84 |
| Southeast Alaska..... | do. | 33 | 1,033,339 | 419,046 | 40.55 | 98,324 | 10.51 |
| Puget Sound..... | do. | 27 | 813,269 | 501,857 | 73.90 | 91,991 | 8.84 |
| Columbia River..... | do. | 10 | 728,221 | 587,879 | 80.72 | 47,891 | 15.11 |
| Outside rivers ^a | do. | 10 | 394,779 | 376,224 | 95.29 | 34,417 | 11.48 |
| Totals and averages..... | | 92 | 3,349,017 | 2,044,915 | 61.05 | 316,429 | 10.58 |
| West Alaska..... | Pinks..... | 2 | 3,968,391 | 1,175,748 | 29.70 | 219,508 | 18.03 |
| Central Alaska..... | do. | 10 | 5,221,887 | 2,172,476 | 41.62 | 324,230 | 16.11 |
| Southeast Alaska..... | do. | 33 | 24,166,834 | 10,473,748 | 43.30 | 1,362,187 | 17.26 |
| Puget Sound..... | do. | 26 | 11,805,603 | 6,391,891 | 53.80 | 858,396 | 13.68 |
| Columbia River..... | do. | 1 | 77,081 | 14,635 | 18.98 | 4,761 | 16.21 |
| Outside rivers ^a | do. | 1 | 62,892 | 62,892 | 100.00 | 4,222 | 14.89 |
| Totals and averages..... | | 73 | 45,292,778 | 20,261,390 | 44.90 | 2,773,394 | 16.29 |
| West Alaska..... | Chums..... | 9 | 527,982 | 194,962 | 36.92 | 54,215 | 9.74 |
| Central Alaska..... | do. | 33 | 728,514 | 418,419 | 57.43 | 79,298 | 9.20 |
| Southeast Alaska..... | do. | 26 | 4,087,578 | 2,554,958 | 62.49 | 480,895 | 8.50 |
| Puget Sound..... | do. | 27 | 2,547,457 | 1,852,350 | 72.71 | 249,390 | 10.22 |
| Columbia River..... | do. | 8 | 277,836 | 123,436 | 44.42 | 28,085 | 9.89 |
| Outside rivers ^a | do. | 7 | 88,736 | 84,413 | 95.12 | 11,655 | 7.61 |
| Totals and averages..... | | 119 | 8,258,103 | 5,228,548 | 63.31 | 903,448 | 9.14 |
| Puget Sound..... | Steelheads..... | 1 | 33 | 33 | 100.00 | 5 | 6.60 |
| Columbia River..... | do. | 10 | 138,421 | 145,581 | 105.01 | 22,234 | 6.71 |
| Outside Rivers ^a | do. | 1 | 787 | 787 | 100.00 | 126 | 6.24 |
| Totals and averages..... | | 12 | 139,241 | 146,401 | 105.00 | 22,365 | 6.22 |

^a Coastal streams in Washington, Oregon, and California.

The following table shows the relative importance of different species within each district. In 1916 the red or sockeye salmon was the most abundant, but in 1917 the humpback had usurped this place by a small margin.

RELATIVE IMPORTANCE OF DIFFERENT SPECIES WITHIN EACH DISTRICT.^a

[Per cent which each species is of total pack by districts.]

| District. | King or chinook. | Red or sockeye. | Medium red. | Pinks or hump-back. | Chum. | Steel-head. | Total, all grades. |
|------------------------|------------------|-----------------|-------------|---------------------|-------|-------------|--------------------|
| 1916. | | | | | | | |
| West Alaska..... | 1.6 | 85.4 | 1.6 | 2.6 | 8.8 | ..... | 100 |
| Central Alaska..... | 2.0 | 53.7 | 5.1 | 32.9 | 6.3 | ..... | 100 |
| Southeast Alaska..... | .8 | 11.8 | 8.1 | 57.7 | 21.6 | ..... | 100 |
| Puget Sound..... | 5.5 | 11.4 | 21.4 | .2 | 61.4 | 0.1 | 100 |
| Columbia River..... | 69.9 | 1.1 | 11.2 | .1 | 13.5 | 4.2 | 100 |
| Outside rivers..... | 40.0 | 5.4 | 29.7 | 3.0 | 21.8 | .1 | 100 |
| Per cent of total..... | 8.6 | 36.8 | 8.3 | 26.6 | 19.4 | .3 | 100 |
| 1917. | | | | | | | |
| West Alaska..... | 1.2 | 95.1 | .3 | .2 | 3.2 | ..... | 100 |
| Central Alaska..... | 1.9 | 72.2 | 3.6 | 13.3 | 9.0 | ..... | 100 |
| Southeast Alaska..... | .9 | 6.5 | 4.5 | 65.3 | 22.8 | ..... | 100 |
| Puget Sound..... | 3.1 | 21.1 | 6.4 | 51.7 | 17.7 | ..... | 100 |
| Columbia River..... | 71.2 | 1.5 | 13.6 | .1 | 9.9 | 3.7 | 100 |
| Outside rivers..... | 39.9 | 2.8 | 32.9 | 9.2 | 15.0 | .2 | 100 |
| Per cent of total..... | 6.9 | 34.2 | 5.1 | 38.3 | 15.3 | .2 | 100 |

^a Report of the Federal Trade Commission: Op. cit., p. 33.

The following table shows the relative importance of districts in the production of each species in 1916 and 1917. Southeast Alaska leads in each year, with 35.1 and 38.1 per cent, respectively. Western Alaska was second in 1916, but was forced down to third place by Puget Sound in 1917. In 1916 Central Alaska produced 21 per cent of the humpback pack, but in 1917 this was reduced to 4.1 per cent. Puget Sound advanced from 0.1 per cent of the humpback pack in 1916 to 30.7 per cent in 1917. Humpbacks run in this district only every other year.

RELATIVE IMPORTANCE OF DISTRICTS IN PRODUCTION OF EACH SPECIES.^a

[Per cent of total amount of each species packed in various districts.]

| District. | King or chinook. | Red or sockeye. | Medium red. | Pinks or hump-back. | Chum. | Steel-head. | Total, all grades. |
|-----------------------|------------------|-----------------|-------------|---------------------|-------|-------------|--------------------|
| 1916. | | | | | | | |
| West Alaska..... | 4.9 | 59.9 | 4.9 | 2.5 | 11.8 | ..... | 25.9 |
| Central Alaska..... | 4.0 | 24.8 | 10.5 | 21.0 | 5.5 | ..... | 17.0 |
| Southeast Alaska..... | 3.3 | 11.2 | 34.4 | 76.0 | 39.1 | ..... | 35.1 |
| Puget Sound..... | 6.9 | 3.4 | 28.1 | .1 | 34.4 | 0.6 | 10.8 |
| Columbia River..... | 66.9 | .3 | 11.2 | .1 | 5.8 | 98.5 | 8.2 |
| Outside rivers..... | 14.0 | .4 | 10.9 | .3 | 3.4 | .9 | 3.0 |
| Total..... | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1917. | | | | | | | |
| West Alaska..... | 3.4 | 53.5 | 1.3 | .1 | 4.0 | ..... | 19.1 |
| Central Alaska..... | 3.3 | 24.9 | 8.2 | 4.1 | 6.9 | ..... | 11.8 |
| Southeast Alaska..... | 4.9 | 7.2 | 32.8 | 64.6 | 57.0 | ..... | 38.1 |
| Puget Sound..... | 10.3 | 14.0 | 28.0 | 30.7 | 26.1 | ..... | 22.6 |
| Columbia River..... | 66.7 | .2 | 17.1 | .0 | 4.1 | 98.4 | 6.4 |
| Outside rivers..... | 11.4 | .2 | 12.6 | .5 | 1.9 | 1.6 | 2.0 |
| Total..... | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

^a Report of the Federal Trade Commission: Op. cit., p. 34.

MILD CURING.

The beginning of the business of mild-curing salmon, or "sweet pickling," as it is sometimes called, is of comparatively recent date.

In 1889 a German dealer came to the Columbia River and tried to interest some of the cannery men in the business. J. O. Hanthorn, M. J. Kinney, and J. W. Cook were persuaded to prepare some, and the plant of the Northwest Cold Storage Co., at Portland, was used to keep the fish at a low temperature during repacking and preparation for shipment. These fish were shipped to Germany, but the shippers received no financial returns, word coming back that the fish were not satisfactory.

Owing to this lack of success from the first effort, no further attempt was made until 1894, when Mueller & Loring, of Chicago, put up a carload of mild-cured salmon at Kalama, Wash., and shipped it to Germany. In 1896 Charles Ruckles and Wallace Bros., of Kalama, packed several carloads for the German market. It was not until 1898 that the business was permanently established on the Columbia, the Trescott Packing Co. and S. Schmidt & Sons putting up plants at Warrenton and Astoria, respectively.

In 1900 the Trescott Packing Co. began packing the spring and fall runs, and the Sacramento River Packers' Association packed the fall run, on the Sacramento River, the business being carried on here every year since.

In 1901 the Sacramento River Packers' Association began at Monterey the mild curing of the spring salmon that were taken with hook and line in the open ocean.

S. Elmore & Co. started the industry in 1902 at Tillamook, and the business began on Puget Sound in 1901, when the San Juan Fishing & Packing Co. and the Seattle Fish Co. took it up. The Pacific Cold Storage Co. began the next year at Anacortes.

Prior to 1906 several of the Alaska cannery men put up each season a few tierces of mild-cured salmon, but it was not until this time that the industry really began as such. In that year J. Lindenberger (Inc.) started packing at Ketchikan, Alaska. The following year several other plants were started, and in 1910 almost all of the king salmon taken in southeast Alaska were mild cured. The same is true to-day.

For mild curing the fresh fish must be given greater care in handling than is the case with any other process. Care must be exercised to see that the flesh of the fish is not bruised or broken, and in order to make sure of this the handlers usually pack several fish in one box, with cracked ice over and around them if the weather is warm. As soon as a box is filled, it is put in the hold, where the boxes are stacked one upon another, but prevent more weight than is represented inside one box coming upon any one fish.

In dressing, the head is removed, care being taken to leave as much of the bony structure of the head as possible to assist in holding the side of the hooks when it is being smoked later on: the fish is then split down the belly to the vent, the entrails removed, when a cut is made on either side of the blood clot in the back, and the fish passed to the "washer," who holds the fish on its back in a slot on the table under a spray of water, and removes the membrane of skin which covers the inside of the backbone and inside of which a good

deal of thick blood lies, by means of a large spoon or some similar form of scraper. A knife should not be employed. Some curers do not remove the fins at this stage, while others do.

The body is then scored along the sides with a small knife, care being used to cut the skin only: this allows the salt to penetrate more freely and thus assist the process of cure. A specially prepared eccentric wheel is sometimes used for this purpose, which makes a series of small cuts varying from half an inch at the tail to $1\frac{1}{2}$ inches long at the shoulder, and from 2 to 3 inches apart.

The fish is now ready for the splitter, who turns it on its back with the open belly toward him and forces the shoulder down on a sharp-pointed nail, so the fish will not slip during the operation. A cross-cut is first made across the root of the tail to the bone, but no deeper. Then the knife is entered at the vent, immediately above the bone, and a cut, which should go no farther back than the middle of the backbone, is drawn down to the crosscut already made. Then raising the lug with his left hand, the splitter enters the knife at the shoulder above the bone, and with one sweep from head to tail, separates the entire side. This is the more easily done if the fins have been previously removed. If the work is perfect, there will be no flesh left on the bone, but a line of fat will show down the center of the side. This improves the appearance of the fish and adds to its value.

In order to remove the bone from the remaining half of the fish, the splitter inserts the knife under the bone, about the vent, and draws down toward the tail, but care must be taken, as before, not to go farther back than the spine. The splitter now takes the fish off the nail, holding it by the lug, his left thumb resting on the upper, or inside of the fish, and his fingers on the lower, or skin side. The tail is now pointing away from the splitter, who enters his knife carefully under the backbone, and with one dextrous outward sweep separates the bone from the fish right down to the root of the tail. When abreast of the crosscut, however, he turns the knife sharply downward, and cuts off the fish the same as on the other side. As with the first half, no flesh should be left adhering to the bone, and the line of fat should show down the center. In other words, the two sides should be exactly alike.

The sides are dipped into cold water in the dress tank, and are then laid, skin side down, on the table with the thin or belly edge toward the front. A man then removes any blood remaining in the veins on the inside of the fish, by pressing it away from him toward the back of the fish, either with his fingers or with a spoon. If the blood is not squeezed out in this way the salt will harden it during the process of curing, and the flesh will become dark in color. The sides are then dipped in a tank of weak brine and crushed ice to give them a final wash, but should on no account be left to soak in the brine. Upon removal, they are again scraped to insure the removal of all the blood from the veins.

Great care must be used in handling the newly split sides, as they are very tender and may be easily broken or bruised. In lifting them by the lug or collar bone, the curer should have his fingers to the inside and his thumb to the outer or skin side; otherwise the skin may be broken.

The sides are then taken to the salter, who lays them, skin side down, on a salting table, on which has been dumped a quantity of dairy salt, and gently rubs the flesh with the salt, lifts it up with only such salt as will adhere to it, and places it in the tierce.

The tierces in which the salmon sides are packed are stout casks made of fir or spruce, bound with six strong galvanized hoops. They contain about 800 pounds of fish, but when full of pickle the gross weight of cask and content is between 1,100 and 1,200 pounds. A plug hole is bored in the head of the tierce.

Two or three handfuls of salt are thrown over the bottom of the tierce, then a layer of salmon sides, skin down, and two or three handfuls of salt are sprinkled over them. In packing two sides of fish, crossed head and tail are packed close to opposite sides of the tierce, the back or thick part of each side being placed close up against the side of the tierce. Other sides of fish are packed from the sides toward the center of the tierce, napes and tails alternately, the back of each side being drawn halfway up and resting on the side already laid. When complete, the layer should be perfectly level, and this depends a good deal on how the last or center piece is laid. Salt is sprinkled between each layer in the manner and quantity noted above and the process continued until the tierce is full. The tiers should be crossed in packing. The top layer should be placed with the skin up and have extra salt put on. From 85 to 100 pounds of salt are used to 800 pounds of fish.

The tierce is then headed up, after which pickle is poured in until the tierce is quite full. This pickle may be made with the same salt as is used for rousing and sprinkling the fish. Perfectly clear water should be provided and broken ice should be added in liberal quantities, if the weather is warm. Before using, the pickle should be strained through a fine sieve or a clean cloth, to remove froth and sediment. A centigrade saltmeter is used by most mild curers. The pickle is made to a strength of at least 90°, but it usually weakens to about 70° during the first 10 days of cure, whereas after repacking it should not readily come below 85°, and it should retain that strength for a long time.

When tierces have been filled with pickle they are rolled inside a cold-storage room, with a temperature of 35 to 38° F., where they may be tiered two tiers high. Very little variation in the temperature is allowable, as it would start the oil or fat in the flesh, allowing it to escape into the brine.

Unless the tierces are kept quite full of pickle the sides of fish are apt to be broken when the cask is rolled about. The tierces must be examined frequently to see that they are full of brine, as there are always small leaks, while the staves absorb more or less moisture. Furthermore, if the tierces were allowed to leak, ugly yellow spots would show on the parts of the fish that were left dry. Thus it is of the utmost importance, both during the two or three weeks allowed for pining and also after repacking, to see that they are kept full of pickle. Several gallons of pickle may be absorbed by each cask during the first two or three weeks of cure.

The actual shrinkage during the two or three weeks in which the fish lie in the first packing may be reckoned at 30 per cent. Fat, well-conditioned fish, especially those which are caught in the ocean, shrink less, but poor fish, especially those caught when well on their

way to the spawning grounds, shrink more—sometimes up to 35 per cent.

After holding the fish in storage for at least 20 and not more than 90 days they are taken out of the tierces. Each side of fish should be lifted out carefully, as described above, and sponged with a large sponge until all salt and slime are entirely removed, leaving only a clean, red side of fish. Either pure ice water or ice pickle may be used for this washing, but it will depend entirely on the quality and condition of the fish. Soft, poor fish would require pickle, but good firm fish may be washed in clean ice water.

The sides are then weighed and graded accordingly, 6 to 8 pounds, 8 to 10 pounds, and so on, being the grades. Sides of 11 pounds and over are called *large* fish, and "L" is marked on the side of the tierce. Some curers grade their sides from 9 to 11 pounds and class them as *medium* and mark them "M;" smaller sides are termed *small* and are marked "S."

After the sides have been graded they should be counted and repacked, the defective sides, such as thin-bellied, torn or broken, being put by themselves. Fish which are considered perfect are called No. 1; those which do not come up to that standard are termed No. 2, and are marked accordingly; while fish that have any taint of sourness are marked "T." In repacking, the sides of fish should be replaced as nearly as possible in their original position, those curved in shape being placed against the sides of the cask and straight pieces laid in the center of the tier. No salt is used in repacking, but as soon as the tierce is filled, the head put in, and the air test applied it is laid on its bilge and filled up with ice-cold pickle made to a strength of 90° salometer (90 per cent saturation) that can be made from fresh or salt water, whichever is handiest and cleanest, half-ground salt being used. There will be about 830 pounds of fish on an average in the tierce after repacking, and some 14 gallons of pickle may be required to fill the cask up. They are then put back into cold storage and pickled at the bilge daily for at least a week. If kept for any length of time, they would, of course, have to be tested, regularly—a tap with a hammer would do—and any leakage promptly rectified. If properly cured, the fish should keep in good condition for months in cold storage, provided the casks are sound and kept full of pickle.

On the head of each tierce are put the following marks: Initials of packer or packers; initials of place where packed; number of tierce (consecutive); number of sides in tierce, the tare, and the gross weight (weight of pickle not counted); quality of fish (I, II, or T); and size of fish (L, M, or S).

If of first quality, no mark is necessary, but second-quality and tainted fish have to be noted.

In the early days of the industry different preparations, which included salicylic and boracic acids, were used to help preserve the fish. This caused much complaint from the Germans, and finally their Government subjected our product to a rigid inspection, with most salutary results, as now it is one of the purest and best products put up on this coast, the use of acids being done away with entirely.

The king salmon is almost invariably the species mild cured, being the only one large enough to answer the requirements of the trade. In 1907 a Ketchikan (Alaska) packer put up a quantity of coho, dog, and humpback salmon, but he found so much difficulty in disposing

of the product that he abandoned further efforts in this line. A few cohos are put up each year.

The principal consumers of the mild-cured salmon are the smokers, who take them from the tierce, wash and soak them for a few minutes, and then have a practically fresh fish to smoke, and not, as in the days when hard-pickled salmon were used, one that had lost most of its oil and flavor through the excessive amount of salt needed to preserve it.

The greater part of the product put up on this coast goes to Europe, Germany being the principal consumer, but considerable quantities are sold in Norway, Sweden, and other countries, while the smokers of the cities east of the Rocky Mountains use large quantities every year.

In Germany, the principal market for mild-cured salmon, nearly all of the fish are smoked. One of the most popular ways of using the smoked salmon is in the making of sandwiches, and probably the greater portion of these are used in the beer halls and the automatic restaurants in that country.

PICKLING.

The earliest method of preserving salmon on the coast was by pickling. At times this industry attained to large proportions, but during the last 10 years it has been declining, largely because the canners are able to pay more for the raw fish than the salters. All species of salmon are pickled, but the most popular is the red salmon.

In dressing salmon for pickling the head is removed, the fish split along the back, the cut ending with a downward curve on the tail. The viscera and two-thirds of the backbone are removed, and the blood, gurry, and black stomach membrane scraped away. The fish are then thoroughly scrubbed and washed in cold water. They are next placed in pickling butts with about 15 pounds of half-ground salt to every 100 pounds of fish. The fish should be laid in a tier, flesh side up, and the salt well sprinkled over it, repeating until the tank is full. Several boards are then laid across the fish and these are weighted down with large stones in order to keep the fish submerged in the pickle which will form. The fish remain here about one week, the brine being held at about 90°. They are then removed, rubbed clean with a scrub brush, and repacked in market barrels, one sack of salt being used to every three barrels of 200 pounds each. About 40 to 52 red salmon, 25 to 35 coho salmon, 70 to 80 humpback salmon, 10 to 14 king salmon, and 25 to 30 dog salmon are required in packing a barrel of pickled salmon.

A few salteries also pack "bellies." This product is merely the belly of the fish, which is the fattest portion, and as most of the packers threw away the rest of the fish, thus causing a very large waste of choice food, this method has come under the ban of the law in some of the coast States and in Alaska. As a result, but few "bellies" are packed now, and most of these only when some economic use is made of the remainder. Humpback salmon furnish the major part of the "belly" pack.

In preparing salmon bellies, the operator first cuts off the two pectoral fins, and then removes the head, care being taken to follow the curve of the body until the backbone is reached, which should

then be severed straight across. With the smaller salmon the fish is then turned on its back, and the operator inserts his knife in the body just above the backbone and cuts down through the body, the knife coming out just in front of the vent. If properly done, the cut will come close to the upper wall of the stomach. With large king salmon it is sometimes necessary to make the cut first on one side, then turn the fish over and make the cut on the other side. The belly is then laid flat on the cutting table and the membrane at one end cut so the belly will lie flat. The bellies are then washed and salted the same as hard-salted salmon.

When bellies are cut, the backs are saved and either dried in the open air, without salt, or else pickled.

With large kings, the operator, after the belly has been cut out, scrapes the inside of the remainder of the carcass. The knife is then inserted under the backbone at the end nearest the tail, and it is cut away with as little flesh as possible adhering to it. The blood is then scraped off, the fish thoroughly washed, and then salted the same as the whole fish.

Some of the old-time fishermen save parts of the salmon heads as food. In this event, the head is split lengthwise clear to the bony covering which protects the top of the head. The gill rakers are then removed from each side of the split head, leaving the nutritious parts intact. The cleaned heads are then salted down the same as whole salmon.

DRY SALTING.

During the progress of the Russian-Japanese War the preparation of dry-salted dog salmon became an important industry, but as soon as the Japanese fishermen resumed their former occupations the demand fell off so much that the industry was virtually abandoned in the United States, although a number of Japanese continue it in British Columbia. The fish, after being dressed, were packed in boxes, in salt, these boxes holding about 560 pounds of fish, and were shipped in this condition to Japan.

At a number of places in Alaska the bellies of red and coho salmon are cut out and salted, after which the backs are dried in the sun and, thus cured, are used for fox food at the numerous fox ranches. This product is called "ukalu."

SMOKING.

The smoking of salmon is virtually a continuation of the pickling, as the fish must be pickled before being smoked, the main purpose of the pickling being to preserve them until the time arrives for smoking, which may be weeks or months after the fish are caught. For smoking the salmon are taken out of the barrel and soaked until as much of the salt as possible is removed. They are then put into the smokehouse and subjected to the heat and smoke of a fairly hot fire for about two days in order that they may be thoroughly dried and hardened. Exposure to a smoldering fire (alder wood is a favorite fuel) for about three days completes the process.

For shipment smoked salmon are packed in wooden boxes, oil paper being placed between the fish.

In the manufacture of smoked salmon, the mild-cured product is most in demand. The necessary quantity of sides is taken from the

cold-storage and placed in large tanks filled with fresh water. In these they are soaked over night, the water being changed several times, depending upon the salinity of the fish, the variation of which depends upon the length of time the product has been held in storage, those held longest absorbing the most salt.

After soaking, the sides are taken from the tanks, piled on tables, and allowed to drain as much as possible. They are then taken one at a time, laid flesh side down, and a bacon hanger, which is made of wire and has six or more points bent at right angles to the frame, terminating at the top in a hook, is pressed firmly into the flesh on the skin side and at the upper end of the side. They are then hung upon a round stick, which latter is then set in position in the smokehouse, each end resting upon supports on the side. The fish are placed so that no two of them will touch. When the smokehouse is full, a small fire of any nonresinous wood is then built underneath to dry them, the ventilator in the top being left open so the moist air can escape. The fires should not be allowed to become too hot; the object is to give the fish smoke rather than heat, as in the latter case they would become partially cooked. For a mild cure, for ready consumption, from 8 to 10 hours, according to the condition of the fish, should be sufficient. If immediate sale should not be possible the fish must be kept in a cold-storage room with a temperature of about 24° F.

In sections where the products move more slowly into consumption, a harder smoking is wanted. In this event, they are held over the fire until dried, which would depend upon climatic conditions, but probably around two days. After the fish have dried sufficiently, the fire is smothered with sawdust, which produces a dense smoke, giving the sides their color. During the latter period the ventilator is partly closed, but must be watched to prevent the fish from sweating.

When thoroughly smoked the sides are removed from the smokehouse, taken off the hanger, and each side wrapped in paper, then packed in wooden boxes holding each 30 pounds.

Kipperd salmon.—On the Pacific coast practically all of the kippered salmon is prepared from frozen white-meated king salmon, which on account of the color of the flesh is not in much demand. It is, however, fully the equal, in both flavor and food value, of the red-meated kings. It is not absolutely essential that the fish be first frozen, as the fresh fish may be kippered after dressing, but the latter is always a little soft when so prepared, owing to an excess of moisture, which is largely removed in freezing. Fresh salmon is available only part of the year, so it is found most convenient to freeze and store the stock and work it up when needed throughout the year.

Before freezing, the fish have been dressed, so when thawed in cold-running water, it is only necessary to split and cut them into pieces of a pound or less, these being about 6 inches long, or perhaps 3 inches broad, depending upon the part of the fish the piece is taken from, and place them in a tank of strong brine to season for several hours. They are then dipped in a harmless vegetable coloring, similar to that used by the butchers for coloring sausage; this gives the outside of the product a red color, a concession to popular prejudice.

From the coloring tank, the pieces are placed on a tray with wood frame and bottom of one-half inch square meshed wire; care is taken that the pieces do not touch each other.

The tray is then slipped into a rack which will hold a number of these, placed one above the other, and this rack is then run on a track into the smokehouse.

A medium fire is then kindled which dries and slightly smokes the pieces from 16 to 18 hours.

When they reach a proper stage the fire is enlarged, but great care must be exercised in order to prevent their being overheated, and this is done by means of the damper at the bottom of the smokehouse and the ventilator at the top. The fish are baked in this manner from 25 to 35 minutes, the thermometer showing from 250 to 275° of heat.

When the cooking is completed the cars are pulled out and the fish allowed to cool, after which each piece is wrapped in a square of parchment paper and packed in a box or basket which holds 10 pounds.

The product is quite perishable, and if it can not be used at once, when of course it is at its best, must be placed in cold storage. The packer endeavors to turn out daily only the amount he can market that day.

Beleke.—A smoked product, known locally as "beleke," is put up at Kodiak, Alaska, from red and coho salmons. Steelhead trout are the best for this purpose, but are not often utilized owing to their scarcity in this region. In preparing "beleke" only the backs of the fish are used, the belly part being cut out and pickled separately. The backs are divided into three grades, according to size, viz, "small," "medium," and "large." They are first put into a brine, the "large" being put in first, followed by the "medium" and "small" at intervals of one hour each, so that all will be cured at about the same time. The coho backs, being the largest, are kept in the brine from 19 to 20 hours, while the red salmon backs, which are smaller, remain in the brine only about 16 hours. After being thoroughly salted the backs are removed from the brine and rinsed in fresh water, then hung in the air for about 24 hours to dry and to allow a thin skin to form on the outside. They are then hung in the smokehouse, in the presence of a little fire of cottonwood or alder. On dry days the gable windows are thrown open and the wind allowed to pass through while the smoking is going on. The smoking must be done slowly, two weeks being devoted to it.

There is a good demand for this product locally, the fish selling for from 15 to 20 cents a pair, but little effort has been made to extend its sale outside of central Alaska.

FREEZING.

The process of preserving fish by freezing was first introduced in 1888. Previous to this the comparatively ancient method of packing with ice, or in rare instances letting the fish freeze naturally during the winter months, was followed. Packing with ice is in quite general use to-day for shipments of fish which are to be preserved for short periods of time. Cooling with ice never results in a temperature lower than 32° F., which, of course, does not freeze the fish.

The freezing of salmon and steelhead trout began on the Sacramento and Columbia Rivers in the late eighties. It was taken up in a small way on Puget Sound in 1892. That year Wallace Bros. and Ainsworth & Dunn froze a small lot, the work being done for them by the Seattle Ice Co. (now the Ice Delivery Co.), and the venture was so successful that the next year nearly all of the wholesale dealers on the Sound took up the business. The Crescent Creamery, of Tacoma, also engaged in the business for the fish dealers for a year or two shortly thereafter. In 1902 the British Columbia Packers' Association bought a large cold-storage plant at New Westminster, British Columbia, at that time the only large and modern plant in the Province, and began the active freezing of fish. Since then a number of excellent plants have been built and operated. In Alaska the preparing of frozen salmon began in 1902. The San Juan Fishing & Packing Co., soon to be succeeded by the Pacific Cold Storage Co., put up a cannery and cold-storage plant at Taku Harbor, in southeast Alaska, in 1901, though it did not operate the cold-storage portion until 1902. The Taku Harbor Canning & Cold Storage Co. later on succeeded to the ownership and operation of this plant. This is the only plant which was operated in Alaska until the New England Fish Co. erected in 1909 a large plant at Ketchikan for the freezing of halibut primarily, but considerable quantities of salmon have been frozen also.

In 1911 the schooner *Metha Nelson* was fitted up as a floating freezer by the Alaska Packers Association and sent to Kodiak Island. As the vessel arrived in San Francisco shortly before the State's closed season on salmon began, and it was a difficult matter to dispose of the catch before then, the business was abandoned.

In 1912 J. Lindenberger (Inc.) opened a freezing plant at Craig, on Fish Egg Island, Alaska, while the ship *William H. Smith* was outfitted as a floating cannery and freezer by the Weiding & Independent Fisheries Co., at Saginaw Bay, Alaska. The latter operated only one season.

The year 1913 saw quite a development in the industry. The Columbia & Northern Fishing & Packing Co., at Wrangell, the Juneau Cold Storage Co., at Juneau, the Booth Fisheries Co., at Sitka, and the floating cold-storage ship *Glory of the Seas*, by the Glacier Fish Co., at Idaho Inlet, were all started this year.

In 1914 the Ketchikan Cold Storage Co. opened a freezer for the general commercial freezing of fish.

In 1917 the San Juan Fishing & Packing Co. built and operated a cold-storage plant at Seward.

In 1918 Henry Goemaere operated for the first time a plant at Washington Bay; while the National Independent Fisheries Co. and the Trout Fisheries Co. froze salmon at Ketchikan. All the other freezers operated as usual, the only change being the purchase by Libby, McNeill & Libby of the cold-storage plant and cannery of the Taku Harbor Canning & Cold Storage Co. at Taku Harbor.

The freezing of salmon is almost invariably carried on in connection with other methods of handling and preserving, and the purpose is usually to secure the fish when numerous and cheap, freeze them, and then hold them until the runs are over and the fish are once more in good demand at high prices. The business proved so profitable,

however, that the dealers began to look for wider markets for their product. Europe, more especially Germany, was prospected and a profitable market soon developed, with the result that to-day frozen Pacific salmon can be secured in nearly every town of any size in western Europe, while large quantities are marketed all over our own country.

There are four important features in packing and using frozen salmon: (1) To get fresh fish; (2) to keep them cold (about 15° above zero) after they are frozen; (3) to keep a coat of ice on them; and (4) to allow them to thaw slowly in cold water or in the air before cooking.

In selecting salmon for freezing, only the finest and freshest of each species are used. The current belief that freezing destroys the flavor of the fish is erroneous, the flavor depending entirely upon the condition before freezing, and the quicker they are frozen after being caught the better will the natural flavor of the fish be preserved. Frozen salmon are just as wholesome as fresh, and their chemical constituents are almost identical. The danger lies in the temptation to freeze the fish after decomposition has set in, but, fortunately, this is now very rarely practiced in the salmon industry.

The coho, or silver, and the chum, or dog, salmon are the choicest of the salmons for freezing. The other species, except the red, or sockeye, which is too oily and rarely frozen, are also frozen in varying quantities. The steelhead trout, which is ranked by the Pacific coast dealers among the salmon, is considered the choicest fish of all for freezing.

Some of the most modern plants in the country are on this coast. These have numerous freezers, generally, in which a temperature of from 25° to 30° F. below zero can be maintained if desired, although a temperature of more than 10° below zero is rarely ever required. All freezing is by direct expansion and each freezer is piped with about 2 feet of 1½-inch pipe per cubic foot of freezing space. The bunkers in the freezers are in pairs, generally nine pipes wide, spaced 10 inches apart. This leaves about a 3½-foot passage through the center of each freezer opposite the swing doors. The salmon are laid on metal sheets, which are placed on the tiers of pipes.

After freezing the salmon are passed through openings in the rear of the freezers into the glazing room, which has a temperature of about 20° F., where they are dipped into water, and when removed are covered with a thin glaze of ice, which may be thickened by repeated dippings. This is an extra precaution to exclude the air from the fish.

After being thoroughly frozen and glazed, each fish is covered first with a parchment, like rolls of butter, and then with a piece of heavy brown paper. They are then packed in boxes holding about 250 pounds each, placed in cold-storage cars and shipped.

The method of freezing fish in brine is now under serious consideration by a number of fishermen and dealers. A brine freezer may be of small capacity and carried on a fishing boat or it may be a freezer of large capacity at some central point convenient for receiving the catches. In this method a strong brine solution, cooled by circulation through crushed ice, is used for freezing the fish. By this method large fish may be frozen in from 1 to 3 hours, a great saving in time as compared with the method at present in use.



FIG. 38.—SHIP, "WM. H. SMITH," FLOATING CANNERY AND COLD-STORAGE PLANT.

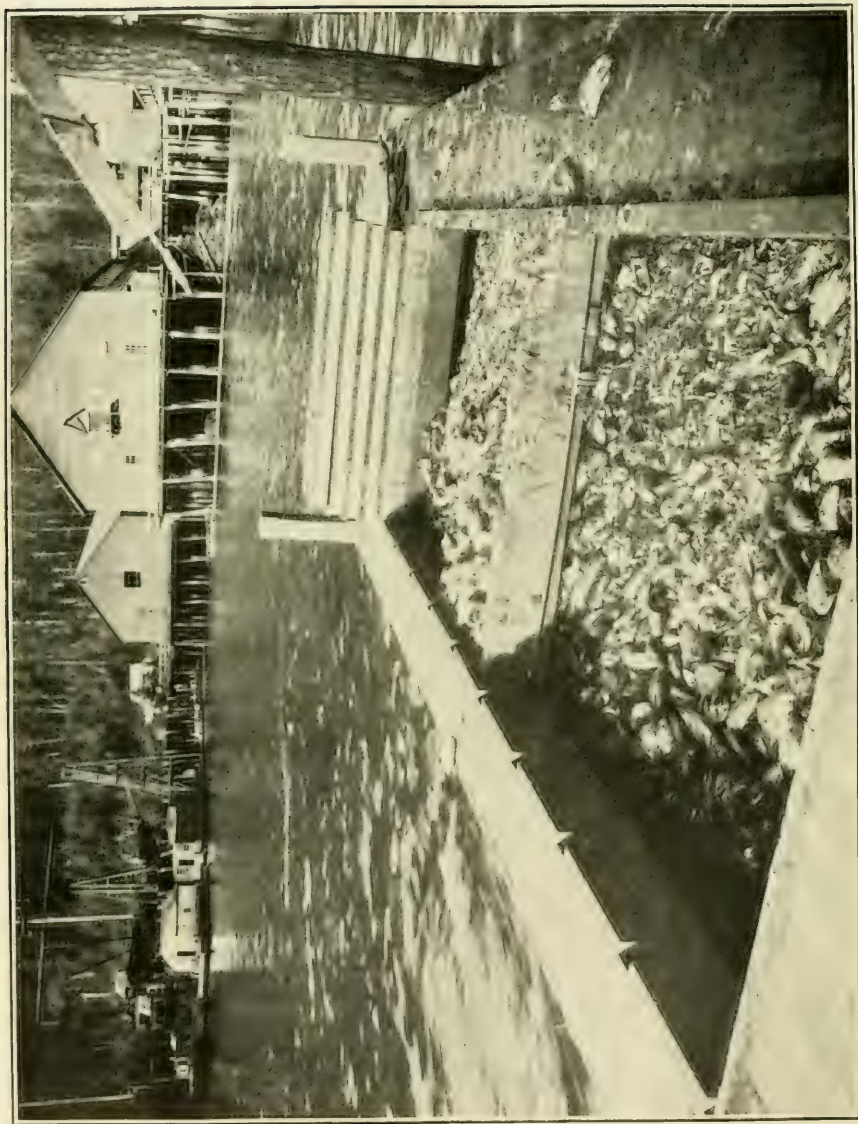


FIG. 39.—SALMON OFFAL READY FOR DELIVERY TO THE FERTILIZER AND FISH-MEAL PLANTS.

UTILIZING SALMON EGGS AND MELT.

Every year immense quantities of salmon eggs are thrown away in the fisheries of the west coast, though there is but little doubt that, if properly prepared, a market could in time be found for this now waste part of the fish. In France there is a good market for a product known as "rogue," which is the spawn of cod, haddock, hake, and pollock, salted in casks, and which is used as bait in the sardine fisheries. Salmon spawn is the choicest and most successful bait used on this coast, and if properly prepared would undoubtedly answer the purpose as well as the regular "rogue" if not better, owing to its oiliness and attractive color. The roes should be soaked for some days in old brine and then packed in strong casks holding about 25 gallons each. It might also prove to be a good bait for tolling mackerel on the Atlantic coast.

In 1910 a considerable quantity of salmon roe was prepared in Siberia and sold in competition with caviar, which is prepared from sturgeon eggs. The product met with favor in Europe and now large quantities are prepared each season.

In this country Miss Ida Tuholski, of San Francisco, who had been engaged in the preparation of sturgeon caviar for some years, put up a number of sample lots of salmon caviar which are fully the equal of the best sturgeon caviar. Capital has been chary, however, about engaging in the business, although undoubtedly it will be an important industry some day.

For making caviar the eggs should be as fresh as possible, and in order to make sure of this the salmon are taken alive, if possible, shortly after coming from the water, killed and bled, the belly opened up and the roe taken out. This work can best be done on work and living scows anchored close to the fishing camps. The roe is placed upon a stand, the top of which is formed of a small-meshed galvanized-iron wire screen. On the underside is arranged a zinc-lined trough. The operator gently rubs the mass of eggs back and forth over the screen, the mesh of which is just large enough to let the eggs drop through, and, as they are separated from the membrane by the rubbing, they fall through into the trough and are thence drawn off into tubs by means of a sliding door at the end of the trough.

After all the roe has been separated the tub is removed and a certain proportion of salt (the sturgeon caviar makers employ the best Luneburg, Germany, salt in this work, while some of the Siberian makers of salmon caviar use No. 2 Berkshire salt from England) is added to the roe, after which the mass is mixed with the hands. The most delicate part of the whole operation is in the manner of mixing. No direct rule can be given for doing this portion of the work, as the condition of the roe regulates the time consumed and the manner of handling. It requires practical experience to become proficient, but this should be an easy matter for one used to handling salted products. The sturgeon caviar makers use about 11 pounds of salt in preparing a keg of caviar.

After the salt has been added the mass of eggs first dries up, but in a few minutes the strength of the salt draws from the eggs their watery constituents and a copious brine is formed, which can be poured off when the tub becomes too full. In Siberia the caviar

makers put the eggs into a brine solution of 19 to 22 per cent Baumé strength immediately after they come from the trough. The salted eggs are then poured into very fine-meshed sieves which hold about 10 pounds each. In the caviar house are arranged long, sloping boards with narrow strips nailed on each side. On these the sieves are placed and left here from 8 to 20 hours in order to thoroughly drain.

The Siberian caviar makers hasten the operation by putting the eggs into a brine solution as noted above, leave them there for from 25 to 45 minutes, then place them in bags and subject them to heavy pressure, after which they are packed. While this method occupies less time, it is not thought the resulting product is as good as that prepared by the slower method outlined above.

The eggs are then transferred to small casks (holding about 135 pounds). The sturgeon caviar makers use oak or pine casks, but some of the Siberian makers say that oak casks turn the salmon caviar black. The casks are steamed before use in order to prevent any possible leakage. It is especially necessary that the kegs or barrels used be air-tight, as otherwise the product will spoil. Barrels such as used in packing salt salmon are rarely ever tight enough to hold caviar. The casks are covered and allowed to stand until the gas escapes and the eggs settle. The vacant space caused by the settling is then filled, the cask headed up and put in a cool place until ready for shipment.

The Siberian salmon caviar makers use a small quantity of "preservaline" in each keg for the purpose of aiding in preserving them, as cold-storage facilities are quite primitive as yet in that country, and it is the addition of this powder which forms the mysterious part to the uninitiated. No preservative would be needed in Alaska, however, as the kegs could be shipped in cold storage along with the mild-cured salmon.

Several establishments are putting up these eggs in jars and hermetically sealed cans for use as bait in sport fishing.

In 1916 one of the companies operating in Alaska put up some salmon melt in cans. No difficulty was experienced in canning this product and it met with considerable favor from those who tried it, but nothing has been done with it since.

MISCELLANEOUS PRODUCTS.

A few years ago a company on the Columbia River put up what was known as "fish pudding." In preparing this the salmon was ground fine, mixed with milk and eggs, and then packed in tin cans. The preparation was soon abandoned.

In 1903 one of the Point Roberts canneries packed a new product which was called "salmon paste." For this the fish was ground up, cooked, seasoned with spices, etc., and made into fish balls, a very palatable dish when warmed over.

In 1905 a Seattle concern began the manufacture of wienerwurst sausages from halibut and salmon.

The Indians in the Bristol Bay region of Alaska occasionally dress the skins of salmon and make of them leather for the tops of boots, also bags and other small articles.

A product, which was first made in Norway, is prepared by means of an invention which quickly dries and pulverizes the flesh of fresh

fish. The resulting powder, called "fish flour," is easy to transport from one place to another and has great nutritive value. It is probable that the tailpieces of the fish, which are at present thrown away, and the cheaper grades of salmon might be prepared in this way and thus furnish another market for salmon.

MEAL, FERTILIZER, AND OIL.

As early as 1888 there was a small plant at Astoria, Oreg., where the refuse of the canneries was utilized for the manufacture of oil and fertilizer. In that year 8,000 gallons of oil (chiefly from salmon heads) and 90 tons of fertilizer were prepared. The oil was worth 22½ cents per gallon and the fertilizer had a market value of \$20 per ton. Most of the refuse was dumped into the river, however. In 1898 a similar plant was established in the Puget Sound district of Washington. At present the plants of the Robinson Fisheries Co. at Anacortes; the Pacific American Fisheries at Eliza Island, near Bellingham; the Wannanwetsch Reducing Co., at Blaine; and the Japanese-American Fertilizer Co. on Lummi Island, all on Puget Sound, operate quite largely on the offal from the Sound salmon canneries.

In 1882 the Alaska Oil & Guano Co. established a fertilizer plant at Killisnoo, Alaska, for the extraction of oil and fertilizer from herring, and has operated the plant continuously ever since. In some years large quantities of whole salmon have been handled at this plant, and the resulting product was found to sell as well as that from herring.

In Alaska the Fish Canners By-Products (Ltd.), in 1914 built a large plant at Ward Cove, near Ketchikan, where salmon offal is used in the preparation of fertilizer, meal, and oil. The company is now experimenting in the preparation of various chemical products from the raw material.

Probably the most serious evil in the salmon industry to-day is the enormous wastage which annually occurs. About one-fourth of the total weight of each fish handled at the various packing plants is thrown away. With the exception of the tailpiece, which is discarded at some canneries owing to the excessive amount of bone which would be in the product if canned, this waste material could not be utilized as food, comprising as it does the head, viscera, fins, and tail. When not conveniently near the very few fertilizer plants at present in operation this product is either allowed to pass through chutes into the water under the cannery, or is dumped into scows and towed to the ocean or the deeper waters of the sounds, and there thrown overboard. This procedure is not only exceedingly wasteful, but is also far from beneficial to the waters where deposited.

The great desideratum in the salmon fisheries of the Pacific coast at the present time is the invention of a small odorless fertilizer plant, costing not more than \$2,500 or \$3,000, which can be installed at the various salmon canneries and salteries. The offal from the cannery could there be utilized and the product obtained would doubtless net a fair return on such an investment, while at the same time the present (in the aggregate) enormous waste would be stopped, and the waters adjacent to the canneries rendered far more agreeable to the fishes as well as to the people on shore. It is absolutely essen-

tial that the plant shall be odorless, as the smell of the ordinary fertilizer establishment would be very offensive to persons visiting the cannery and would not enhance the demand for canned salmon. At the present time the cheapest plant available costs about \$10,000, and very few canneries can afford to invest this sum of money in the disposal of their own offal alone.

A great impetus has been given to the industry during the last two years, owing to the big demand which has come from the farmers and poultrymen for fish meal or scrap, which, after it has been mixed with other ingredients, can be fed to cattle, hogs, and poultry. Experiments carried out at various agricultural experiment stations, both here and in Europe, show conclusively that this class of food increases the appetite of the animal, and consequently the weight, while it does not affect the flavor of the flesh of the animals.

SHIPPING FRESH SALMON DIRECT TO CONSUMER.

An important new feature in the salmon industry is the shipping of individual salmon direct to consumers by express, or, for certain short distances, by parcel post, for a certain fixed sum, which includes the fish itself and the cost of delivering same to the buyer.

This business began in Tacoma, Wash., in 1914, and those who originated it advertised throughout the country that they would ship a fresh salmon to any express office in the United States (except Southern Express), express prepaid, for \$1.25, weight 7 to 8 pounds. In 1915 the cost, delivered east of the Mississippi River, was raised to \$1.50 each, the old rate of \$1.25 still being in force for shipments west of the Mississippi River. The price has since been increased to \$2.50 for any place in the United States. The number of shippers has increased very much, and the business is now carried on from a number of places in Washington, Oregon, and California.

In shipping an individual fish, it is packed in a box containing 20 pounds of cracked ice. These boxes are collected by the express companies and are generally sent out in their own regular cars attached to trains leaving in the evening. About every 15 to 20 hours the box is opened and from 5 to 7 pounds, depending upon the weather, of cracked ice added to the box to make up the loss through melting.

As the Post Office Department will not accept packages in which ice is used for preserving fish, the use of the parcel post for shipments of individual fish is limited to the first postal zone (up to 50 miles from the initial point), except in winter, when the postmasters are authorized, in their discretion, to accept shipments for the second zone (50 to 100 miles from the initial point). In making fresh-fish shipments by parcel post, frozen fish are generally used.

Most of the orders come from the Middle West, where fresh fish are not abundant, but orders are received from all sections of the country.

The success met with in shipping fresh salmon led to a considerable expansion of the industry, with the result that now one can obtain not only a fresh salmon, but also may purchase salt, smoked, and kippered salmon, salt codfish, and fresh halibut, smelt, crabs, and other sea food in their season.

NUTRITIVE QUALITIES OF SALMON.

More and more attention is being paid by the consuming public to the nutritive qualities of the food products offered them, and this is especially true as regards fishery products.

The proper functions of food are two-fold, first, to furnish protein for building and repairing the body, and second, to supply energy for heat and muscular work. Foods which supply an abundance of both at a reasonable price are of the greatest importance from an economical standpoint.

ANALYSES OF CANNED AND FRESH PACIFIC SALMON.

Despite the great prominence of the salmon industry, but little time has been devoted to it by the chemist.

Prof. W. O. Atwater was the first American investigator to devote any portion of his energies to the analysis of Pacific salmon. In "Principles of Nutrition and Nutritive Value of Food" (Farmers Bulletin No. 142, United States Department of Agriculture, 1901), he gives the following analysis of canned Pacific coast salmon:

Water, 63.5 per cent; protein, 21.8 per cent; fat, 12.1 per cent; ash, 2.6 per cent; fuel value per pound, 915 calories.^a

C. F. Langworthy, in "Fish as Food" (Farmers Bulletin No. 85, United States Department of Agriculture, 1898), gives the following analyses of fresh and canned Pacific coast salmon:

Fresh salmon, California (sections): Refuse (bone, skin, etc.), 5.2 per cent; water, 60.3 per cent; protein, 16.5 per cent; fat, 17 per cent; mineral matter, 1 per cent; total nutrients, 34.5 per cent; fuel value per pound, 1,025 calories.

Canned salmon: Refuse (bone, skin, etc.), 3.9 per cent; salt, 1 per cent; water, 59.3 per cent; protein, 19.3 per cent; fat, 15.3 per cent; mineral, 1.2 per cent; total nutrients, 35.8 per cent; fuel value per pound, 1,005 calories.

Dr. Harvey W. Wiley gives the following as the composition of a Pacific coast salmon (species not given):^b

Fresh—Water, 63.61 per cent; protein, 17.46 per cent; fat, 17.87 per cent; ash, 1.06 per cent. Dry—Protein, 52.31 per cent; fat, 49.05 per cent; ash, 2.92 per cent.

On page 137 of the same work Dr. Wiley gives the following as the mean of three samples of Pacific coast canned salmon:

Composition of canned salmon.—Mean of three samples. Water-free substance: Protein, 53.52 per cent; fat, 40.52 per cent; ash, 6.24 per cent.

Prof. Knisely,^c of the Oregon State Agricultural College at Corvallis, Oreg., analyzed canned salmon packed at the Funtier Bay (Alaska) cannery of the Thlinket Packing Co., with the following results:

| Species. | Moisture. | Protein. | Fat. | Ash. |
|-------------------------|------------------|------------------|------------------|------------------|
| | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
| Sockeye or red..... | 64.74 | 24.19 | 9.11 | 2.06 |
| Coho or medium red..... | 68.22 | 26.56 | 3.61 | 1.66 |
| Humpback or pink..... | 69.43 | 24.00 | 4.86 | 1.68 |
| Keta or chum..... | 67.08 | 25.06 | 6.59 | 1.26 |

^a The unit used to show the fuel value is the "calorie," which is the amount of heat required to raise the temperature of about 1 pound of water 4° F.

^b Foods and their Adulteration, etc., p. 135. By Harvey W. Wiley. 8°, Philadelphia, 1907.

^c Pacific Fisherman, Vol. VI, No. 1, January, 1908, p. 21.

H. M. Loomis, formerly chief of the Seattle food and drug inspection laboratory, Bureau of Chemistry, United States Department of Agriculture, reports as follows on analyses of both canned and fresh Pacific salmon made at this laboratory.^a

CANNED SALMON (1911 PACK.)^a

| Sample. | Water. | Ethyl ether extract. ^b | Protein (Nx6.25). | Total ash. | NaCl. ^c | Ammoniacal nitrogen. | |
|-------------------------------------|------------------|-----------------------------------|-------------------|------------------|--------------------|----------------------|-----------------------|
| | | | | | | Richardson method. | Alcohol vapor method. |
| | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
| No. 1. Puget Sound sockeye..... | 62.44 | 15.17 | 20.25 | 2.50 | 0.79 | 0.0403 | 0.0348 |
| No. 2. Puget Sound sockeye..... | 61.84 | 13.74 | 21.77 | 2.73 | 1.10 | .0437 | .0410 |
| No. 3. Alaska medium red..... | 69.97 | 7.81 | 20.40 | 2.58 | 1.09 | .04965 | ..... |
| No. 4. Alaska chum..... | 73.48 | 2.88 | 21.33 | 2.57 | .83 | .0563 | .0557 |
| No. 5. Alaska pink or humpback..... | 74.12 | 4.75 | 19.75 | 1.98 | .50 | .0404 | ..... |
| No. 6. Alaska red..... | 70.88 | 5.26 | 21.79 | 2.35 | .64 | .0455 | ..... |

FRESH SALMON (CAUGHT MAY 7, 1912), EDIBLE PORTIONS.

| | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
|--|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Puget Sound sockeye..... | 67.48 | 8.86 | 22.24 | 1.36 | ..... | 0.0121 | 0.0205 |
| Puget Sound steelhead or salmon trout..... | 67.89 | 9.39 | 21.80 | 1.35 | ..... | .0135 | .0218 |

^a Each sample is average of two or more cans. All samples, except No. 2, are old form 1-pound tall cans. No. 2 is ½-pound flat cans.

^b Represents the fat.

^c Represents the salt.

ANALYSES OF CANNED SALMON BY SOUTH DAKOTA AUTHORITIES.

In 1916 the South Dakota Food and Drug Department analyzed a considerable number of samples of canned salmon for the purpose of determining, if possible, whether inferior grades of the fish were substituted for the better grades, and for the further purpose of discovering some means of identifying the different types of salmon by chemical analysis.

Thirty-three samples of commercial canned salmon, including 30 different brands, were analyzed. Thirteen of these were labeled as belonging to the sockeye class, five to the coho, six to the humpback, and one to the chum. Five samples were not labeled as to variety. One sample was labeled "Salmon Steaks" and two samples were labeled "Fresh Alaska." The last eight samples, because they were not labeled to show the common name of the fish contained in the can, were in violation of the F. I. D. No. 105 referred to above.

All of the cans but one were labeled to show the net weight of fish in the can. Sixteen per cent of them contained less than the declared amount of contents, but the greatest shortage was but 3.1 per cent of the declared weight, while the greatest excess in weight was 18.7 per cent of the declared weight. The weight is usually stated considerably under the actual amount of the contents.

The amount of liquid in the cans is an important factor to consider in computing the value of the contents. The free liquor in the cans examined varied widely from 3.95 per cent in sample number 15-209, labeled salmon steaks, to 26.54 per cent in sample number 15-63, which was not labeled as to variety. As a rule, the largest amount of free liquor is found in the lower priced grades, but there are exceptions, notably number 15-70, which contained 24.14 per cent of free liquor.

It will be noticed from the results given in the table that the amount of total moisture varies inversely as the amount of fat (called ether extract in the table). That is, salmon containing an excessive amount of moisture contains little fat, but those samples which contain the lower amounts of moisture contain the largest amounts of fat. The protein content seems to be fairly constant in all samples, the average amount

^a Salmon Canning Industry of North America. By H. M. Loomis. Original communications, Eighth International Congress of Applied Chemistry, Washington and New York, Sept. 4 to 13, 1912, Vol. XVIII, pp. 239-245. The Rumford Press, Concord, N. H.

being 19.34 per cent, while the minimum found is 15.66 per cent and the maximum 22.45 per cent. The total phosphoric acid varies from 4.2 per cent to 9.8 per cent, the average being 6.6 per cent.

As would be expected, the samples containing the larger proportions of fat liberate the larger quantities of heat units, or calories, per pound, and it will be noted that the price is not in all cases an accurate measure of value, some of the higher priced varieties being in reality much lower in actual cost, when their food value is taken into consideration, than some of the cheaper varieties.^a

The table below has been condensed from that shown in the report. The brand, name of the jobber, and the data about these samples, where the species is not shown on the label, have been eliminated, as they were not essential to our purpose. All of the other data have been reproduced exactly as they appeared in the original report. Not a single one of the samples apparently bore the packer's label, all being jobber's labels.

| Laboratory No. | Variety. | Total moisture. | Ether extract. | Protein. | Ash. | |
|----------------|----------------------|------------------|------------------|------------------|------------------|------------------|
| | | | | | Soluble. | Insoluble. |
| | | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
| 15-56 | Red..... | 52.32 | 17.68 | 19.50 | 2.15 | 0.81 |
| 15-210 | Fancy sockeye..... | 59.29 | 16.83 | 18.28 | 1.63 | .88 |
| 15-209 | Salmon steaks..... | 60.45 | 17.96 | 17.31 | 1.47 | .33 |
| 15-60 | Fancy red..... | 60.46 | 15.40 | 18.22 | 1.33 | 2.89 |
| 15-72 | Sockeye..... | 60.80 | 18.19 | 19.15 | .81 | .78 |
| 15-65 | do..... | 60.95 | 15.94 | 18.56 | 1.50 | 1.11 |
| 15-59 | Red sockeye..... | 61.60 | 15.48 | 16.89 | 1.99 | .67 |
| 15-64 | do..... | 62.18 | 13.10 | 19.13 | 1.45 | .55 |
| 15-204 | Red Alaska..... | 65.44 | 10.57 | 20.31 | 2.15 | .51 |
| 15-58 | Coho salmon..... | 65.65 | 9.62 | 17.32 | 1.61 | 1.33 |
| 15-220 | Red Alaska..... | 66.12 | 8.63 | 21.22 | 1.73 | .62 |
| 15-64 | Coho salmon..... | 67.18 | 9.59 | 17.60 | 1.18 | 1.20 |
| 15-222 | Pink salmon..... | 69.53 | 6.62 | 20.48 | 1.85 | .78 |
| 15-219 | Red salmon..... | 69.87 | 6.36 | 20.38 | 2.24 | .57 |
| 15-207 | Pink salmon..... | 70.45 | 7.28 | 17.66 | 1.53 | .90 |
| 15-221 | Chum..... | 70.52 | 4.57 | 19.73 | .80 | .72 |
| 15-205 | Red salmon..... | 70.86 | 4.04 | 21.11 | 1.60 | .72 |
| 15-70 | do..... | 71.45 | 4.47 | 20.75 | 2.15 | 1.13 |
| 15-61 | Pink salmon..... | 71.64 | 4.35 | 18.31 | 1.56 | 1.60 |
| 15-208 | Gorbouscha b..... | 73.17 | 5.33 | 17.35 | 1.27 | 1.01 |
| 15-206 | Alaska salmon c..... | 73.30 | 2.43 | 21.22 | 1.45 | .45 |
| 15-214 | do..... | 73.76 | 3.98 | 18.31 | 1.62 | .96 |
| 15-57 | Pink Alaska..... | 74.08 | 3.90 | 15.66 | 1.50 | .54 |
| | | | | | | 1.02 |

| Laboratory No. | Variety. | Phosphoric acid, d | | Sodium chloride. | Calories per lb. | Price per lb. |
|----------------|----------------------|--------------------|------------------|------------------|------------------|---------------|
| | | Soluble. | Insoluble. | | | |
| | | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Number.</i> | <i>Value.</i> |
| 15-56 | Red..... | 4.2 | 3.5 | 1.45 | 1,110 | \$0.31 |
| 15-210 | Fancy sockeye..... | 4.2 | 4.0 | .81 | 1,050 | .30 |
| 15-209 | Salmon steaks..... | 3.7 | 1.5 | .51 | 1,080 | .36 |
| 15-60 | Fancy red..... | 2.8 | 3.8 | .53 | 990 | .29 |
| 15-72 | Sockeye..... | 3.1 | 3.7 | .14 | 1,125 | .25 |
| 15-65 | do..... | 2.2 | 5.3 | .68 | 1,020 | .29 |
| 15-59 | Red sockeye..... | 3.6 | 2.6 | 1.10 | 965 | ..... |
| 15-64 | do..... | 3.2 | 3.5 | .60 | 910 | .30 |
| 15-204 | Red Alaska..... | 4.0 | 2.3 | 1.15 | 825 | ..... |
| 15-58 | Coho salmon..... | 2.5 | 5.7 | 1.02 | 730 | .25 |
| 15-220 | Red Alaska..... | 1.9 | 2.8 | .82 | 760 | ..... |
| 15-64 | Coho salmon..... | 2.4 | 5.9 | .53 | 730 | .21 |
| 15-222 | Pink salmon..... | 1.8 | 3.6 | .90 | 660 | ..... |
| 15-219 | Red salmon..... | 2.0 | 2.7 | 1.26 | 545 | ..... |
| 15-207 | Pink salmon..... | 3.4 | 4.1 | .74 | 635 | .15 |
| 15-221 | Chum..... | 1.0 | 4.1 | Trace. | 565 | ..... |
| 15-205 | Red salmon..... | 3.3 | 3.2 | .65 | 560 | ..... |
| 15-70 | do..... | 2.7 | 3.1 | 1.17 | 575 | .30 |
| 15-61 | Pink salmon..... | 2.4 | 4.7 | .84 | 525 | .39 |
| 15-208 | Gorbouscha b..... | 2.0 | 2.1 | .45 | 550 | .15 |
| 15-206 | Alaska salmon c..... | 2.7 | 4.4 | .66 | 500 | .15 |
| 15-214 | do..... | 1.7 | 2.5 | .75 | 510 | .15 |
| 15-57 | Pink Alaska..... | 2.0 | 4.5 | .85 | 455 | .25 |

^a Bulletin, South Dakota Food and Drug Department, Vol. IV, Nos. 2 and 3, October-December, 1916, pp. 8-11.

^b Probably pink salmon (author). ^c Probably chum salmon (author). ^d Mgm. of P₂O₅ per gram.

ANALYSIS OF SALTED SALMON.

Falkenburg & Co., of Seattle, have recently made an analysis of the food value of salted salmon, as follows:^a

Regarding the salmon recently inspected and analyzed for you by ourselves with the following results:

| | |
|-------------------------|------------------|
| Protein..... | 21. 97 per cent. |
| Fat..... | 4. 34 per cent. |
| Salt..... | 19. 08 per cent. |
| Ash..... | . 84 per cent. |
| Moisture..... | 54. 35 per cent. |
| Calories per pound..... | 592 |

If this salmon were freshened, as is the custom in preparing it for the table, removing all but about 2 per cent of the salt, the fish would then have the following analysis:

| | |
|-------------------------|------------------|
| Protein..... | 27. 13 per cent. |
| Fat..... | 5. 36 per cent. |
| Salt..... | 2. 47 per cent. |
| Moisture..... | 65. 11 per cent. |
| Ash..... | 1. 03 per cent. |
| Calories per pound..... | 734 |

Bulletin No. 28 of the United States Department of Agriculture, "Chemical Composition of American Food Products" gives on page 51 the food value of the average canned salmon as purchased as follows:

| | |
|-------------------------|-----------------|
| Refuse..... | 14. 2 per cent. |
| Protein..... | 19. 5 per cent. |
| Fat..... | 7. 5 per cent. |
| Ash..... | 2. 0 per cent. |
| Moisture..... | 56. 8 per cent. |
| Calories per pound..... | 680 |

STATISTICS OF THE SALMON OUTPUT.

SALMON CATCH IN 1918.

The following tables show the total catch, by species, of salmon and steelhead trout on the Pacific coast of North America in 1918, and the catch, by apparatus and species, for each geographic section of Alaska and Washington in 1918:

SUMMARY, BY SECTION AND SPECIES, OF PACIFIC COAST SALMON CATCH IN 1918.

| Section. | Pounds. | Section. | Pounds. |
|--------------------------|---------------|---|---------------|
| Alaska: | | Washington—Continued. | |
| Coho, or medium red..... | 17, 470, 086 | Steelhead..... | 1, 446, 733 |
| Chum, or keta..... | 113, 286, 544 | Sockeye, or red..... | 4, 127, 280 |
| Humpback, or pink..... | 193, 265, 448 | Total..... | 49, 609, 847 |
| King, or spring..... | 16, 010, 764 | Oregon: Salmon ^b c..... | 34, 551, 253 |
| Red, or sockeye..... | 176, 690, 325 | California: Salmon ^b | 13, 026, 076 |
| Total..... | 516, 723, 167 | British Columbia: Salmon ^b | 152, 992, 500 |
| Washington: | | Grand total..... | 766, 902, 843 |
| Coho, or medium red..... | 12, 621, 704 | | |
| Chum, or keta..... | 10, 153, 240 | | |
| Humpback, or pink..... | 353, 568 | | |
| King, or spring..... | 20, 907, 322 | | |

^a Pacific Fisherman, Seattle, Wash., Vol. XVII, No. 4, April, 1919, p. 76.

^b Species not given separately.

^c Estimated.

SALMON CATCH IN 1918, BY APPARATUS AND SPECIES, FOR EACH GEOGRAPHIC SECTION OF ALASKA.^a

| Apparatus and species. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|------------------------|-------------------|-----------------|-----------------|----------------|
| Seines: | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> |
| Coho, or silver..... | 2,239,596 | 546,966 | 23,454 | 2,810,016 |
| Chum, or keta..... | 42,507,872 | 15,239,240 | 1,744,448 | 59,491,560 |
| Humpback, or pink..... | 53,774,192 | 19,615,380 | 443,504 | 73,833,076 |
| King, or spring..... | 368,830 | 32,296 | 119,658 | 521,784 |
| Red, or sockeye..... | 3,979,215 | 9,528,400 | 4,492,510 | 18,000,125 |
| Total..... | 102,869,705 | 44,962,282 | 6,823,574 | 154,655,561 |
| Gill nets: | | | | |
| Coho, or silver..... | 1,495,494 | 2,757,504 | 763,164 | 5,016,162 |
| Chum, or keta..... | 1,589,760 | 2,199,696 | 5,459,944 | 9,249,400 |
| Humpback, or pink..... | 365,540 | 118,388 | 885,992 | 1,369,920 |
| King, or spring..... | 460,570 | 1,983,190 | 2,040,808 | 4,484,568 |
| Red, or sockeye..... | 2,583,605 | 8,688,790 | 117,100,100 | 128,372,495 |
| Total..... | 6,494,969 | 15,747,568 | 126,250,008 | 148,492,545 |
| Pound nets: | | | | |
| Coho, or silver..... | 4,198,356 | 2,030,592 | 60,000 | 6,288,948 |
| Chum, or keta..... | 29,164,536 | 11,275,288 | 1,681,560 | 42,121,384 |
| Humpback, or pink..... | 96,348,688 | 19,941,668 | 1,722,468 | 118,012,824 |
| King, or spring..... | 696,674 | 614,922 | 217,844 | 1,529,440 |
| Red, or sockeye..... | 7,113,930 | 20,191,895 | 1,892,915 | 29,198,740 |
| Total..... | 137,522,184 | 54,054,365 | 5,574,787 | 197,151,336 |
| Lines: | | | | |
| Coho, or silver..... | 1,802,370 | ..... | ..... | 1,802,370 |
| Chum, or keta..... | 236,000 | ..... | ..... | 236,000 |
| Humpback, or pink..... | 37,076 | ..... | ..... | 37,076 |
| King, or spring..... | 8,177,818 | ..... | ..... | 8,177,818 |
| Red, or sockeye..... | 105,540 | ..... | ..... | 105,540 |
| Total..... | 10,358,804 | ..... | ..... | 10,358,804 |
| Dip nets: | | | | |
| Coho, or silver..... | ..... | 51,018 | ..... | 51,018 |
| King, or spring..... | ..... | 195,580 | ..... | 195,580 |
| Red, or sockeye..... | ..... | 1,013,425 | ..... | 1,013,425 |
| Total..... | ..... | 1,260,023 | ..... | 1,260,023 |
| Wheels: | | | | |
| Coho, or silver..... | ..... | ..... | 1,501,572 | 1,501,572 |
| Chum, or keta..... | ..... | ..... | 2,188,200 | 2,188,200 |
| Humpback, or pink..... | ..... | ..... | 12,552 | 12,552 |
| King, or spring..... | ..... | ..... | 1,102,574 | 1,102,574 |
| Total..... | ..... | ..... | 4,801,898 | 4,801,898 |
| Total: | | | | |
| Coho, or silver..... | 9,735,816 | 5,356,080 | 2,348,190 | 17,470,086 |
| Chum, or keta..... | 73,498,168 | 28,714,224 | 11,074,152 | 113,286,544 |
| Humpback, or pink..... | 150,525,496 | 39,675,436 | 3,061,516 | 193,265,448 |
| King, or spring..... | 9,703,892 | 2,825,988 | 3,480,884 | 16,010,764 |
| Red, or sockeye..... | 13,782,290 | 39,422,510 | 123,485,525 | 176,690,325 |
| Grand total..... | 257,245,662 | 116,024,238 | 143,453,267 | 516,723,167 |

^a Figured from data in "Alaska Fisheries and Fur Industries in 1918," pp. 42, 43. By Ward T. Bower. U. S. Bureau of Fisheries Document No. 872, Appendix VII, Report U. S. Commissioner of Fisheries, 1918. Washington, 1919. In changing from number of fish to pounds the species were figured on the following basis: Coho, 6 pounds; chum, 8 pounds; humpback, 4 pounds; king, 22 pounds; and red, 5 pounds.

SALMON CATCH IN 1918, BY APPARATUS AND SPECIES FOR EACH GEOGRAPHIC DISTRICT OF WASHINGTON.

| Apparatus and species. | Puget Sound. | Grays Harbor. | Willapa Harbor. | Columbia River. | Total. |
|------------------------------|----------------|----------------|-----------------|-----------------|----------------|
| Seines, drag: | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> |
| Coho, or silver..... | 148,086 | | | 41,898 | 189,984 |
| Chum, or keta..... | 478,304 | | | 5,600 | 483,904 |
| Chinook, or spring..... | 21,208 | | | 470,448 | 491,656 |
| Humpback, or pink..... | 92 | | | 908 | 1,000 |
| Sockeye, or red..... | 385 | | | 67,845 | 68,230 |
| Steelhead..... | | | | 158,568 | 158,568 |
| Total..... | 648,075 | | | 745,267 | 1,393,342 |
| Seines, purse: | | | | | |
| Coho, or silver..... | 3,083,838 | | | 145,908 | 3,229,746 |
| Chum, or keta..... | 6,398,664 | | | | 6,398,664 |
| Chinook, or spring..... | 325,182 | | | 952,116 | 1,277,298 |
| Humpback, or pink..... | 12,388 | | | 1,540 | 13,928 |
| Sockeye, or red..... | 225,365 | | | 935 | 226,300 |
| Steelhead..... | 95,320 | | | 27,840 | 123,160 |
| Total..... | 10,140,757 | | | 1,128,339 | 11,269,096 |
| Pound, or trap, nets: | | | | | |
| Coho, or silver..... | 4,219,038 | 55,272 | 253,404 | 577,398 | 5,105,112 |
| Chum, or keta..... | 1,390,256 | 22,920 | 132,528 | 93,496 | 1,639,200 |
| Chinook, or spring..... | 8,392,098 | 50,754 | 180,488 | 2,109,294 | 10,732,634 |
| Humpback, or pink..... | 240,724 | | | 688 | 241,412 |
| Sockeye, or red..... | 2,479,550 | | | 90,355 | 2,569,906 |
| Steelhead..... | 95,864 | 56 | 112 | 432,016 | 528,048 |
| Total..... | 16,817,530 | 129,002 | 566,532 | 3,303,247 | 20,816,311 |
| Gill nets: | | | | | |
| Coho, or silver..... | 1,072,860 | 423,570 | 102,162 | 310,698 | 1,909,290 |
| Chum, or keta..... | 749,104 | 102,256 | 40,640 | 262,336 | 1,154,336 |
| Chinook, or spring..... | 856,812 | 415,866 | 133,408 | 4,783,284 | 6,189,370 |
| Humpback, or pink..... | 6,072 | | | 12,320 | 18,392 |
| Sockeye, or red..... | 88,260 | 4,125 | 15 | 534,115 | 626,515 |
| Steelhead..... | 19,624 | 4,120 | 344 | 390,824 | 420,912 |
| Total..... | 2,792,732 | 949,937 | 276,569 | 6,299,577 | 10,318,815 |
| Set nets: | | | | | |
| Coho, or silver..... | 586,776 | 327,780 | 133,508 | 11,340 | 1,059,404 |
| Chum, or keta..... | 211,568 | 95,936 | 130,888 | 13,024 | 451,416 |
| Chinook, or spring..... | 332,662 | 168,652 | 28,930 | 103,004 | 633,248 |
| Humpback, or pink..... | 2,216 | 644 | | 26,072 | 28,932 |
| Sockeye, or red..... | 770 | 1,630 | 470 | 105,975 | 108,845 |
| Steelhead..... | 66,528 | 26,832 | 4,552 | 62,256 | 160,168 |
| Total..... | 1,200,520 | 621,474 | 298,348 | 321,671 | 2,442,013 |
| Reef nets: | | | | | |
| Coho, or silver..... | 75,804 | | | | 75,804 |
| Chum, or keta..... | 7,312 | | | | 7,312 |
| Chinook, or spring..... | 33,330 | | | | 33,330 |
| Humpback, or pink..... | 49,792 | | | | 49,792 |
| Sockeye, or red..... | 10,180 | | | | 10,180 |
| Total..... | 176,418 | | | | 176,418 |
| Fish wheels: | | | | | |
| Coho, or silver..... | | | | 66 | 66 |
| Chinook, or spring..... | | | | 212,410 | 212,410 |
| Sockeye, or red..... | | | | 508,915 | 508,915 |
| Steelhead..... | | | | 53,408 | 53,408 |
| Total..... | | | | 774,799 | 774,799 |
| Bag nets: | | | | | |
| Coho, or silver..... | 300 | | | | 300 |
| Chum, or keta..... | 16,400 | | | | 16,400 |
| Chinook, or spring..... | 66 | | | 2,750 | 2,816 |
| Steelhead..... | | | | 808 | 808 |
| Total..... | 16,766 | | | 3,558 | 20,324 |

SALMON CATCH IN 1918. BY APPARATUS AND SPECIES FOR EACH GEOGRAPHIC DISTRICT OF WASHINGTON—Continued.

| Apparatus and species. | Puget Sound. | Grays Harbor. | Willapa Harbor. | Columbia River. | Total. |
|-------------------------|----------------|----------------|-----------------|-----------------|----------------|
| | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> |
| Hooks and lines: | | | | | |
| Coho, or silver..... | 638,436 | 34,170 | 3,036 | 376,356 | 1,051,998 |
| Chum, or keta..... | 960 | 888 | | 160 | 2,008 |
| Chinook, or spring..... | 391,312 | 8,160 | 1,184 | 933,904 | 1,334,560 |
| Humpback, or pink..... | 112 | | | | 112 |
| Sockeye, or red..... | 2,645 | | | 5,745 | 8,390 |
| Steelhead..... | 64 | | | 1,597 | 1,661 |
| Total..... | 1,033,529 | 43,218 | 4,220 | 1,317,762 | 2,398,729 |
| Total: | | | | | |
| Coho, or silver..... | 9,825,138 | 840,792 | 492,110 | 1,463,664 | 12,621,704 |
| Chum, or keta..... | 9,252,568 | 222,000 | 304,056 | 374,616 | 10,153,240 |
| Chinook, or spring..... | 10,352,670 | 643,432 | 344,010 | 9,567,210 | 20,907,322 |
| Humpback, or pink..... | 311,396 | 644 | | 41,528 | 353,568 |
| Sockeye, or red..... | 2,807,155 | 5,755 | 485 | 1,313,885 | 4,127,280 |
| Steelhead..... | 277,400 | 31,008 | 5,008 | 1,133,317 | 1,446,733 |
| Grand total..... | 32,826,327 | 1,743,631 | 1,145,669 | 13,894,220 | 49,609,847 |

BRISTOL BAY WATERS SALMON CATCH, 1913 TO 1917.

Broadly speaking, about one-third of the yield of salmon from Alaskan waters comes from the important Bristol Bay region. The following table shows the catches made in the more important waters fished in the Bristol Bay district in the period of five years from 1913 to 1917:

SALMON CATCH, BY STREAMS, IN BRISTOL BAY REGION, 1913 TO 1917.^a

| Species and stream. | 1913 | 1914 | 1915 | 1916 | 1917 | Total. |
|-----------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | <i>Number.</i> | <i>Number.</i> | <i>Number.</i> | <i>Number.</i> | <i>Number.</i> | <i>Number.</i> |
| Red salmon: | | | | | | |
| Nushagak..... | 5,236,008 | 6,174,097 | 5,676,457 | 3,592,574 | 5,679,818 | 26,358,954 |
| Igushik..... | 173,925 | 283,718 | 228,405 | 223,343 | 167,421 | 1,076,812 |
| Kvichak-Naknek..... | 13,691,059 | 12,584,809 | 7,156,488 | 11,551,086 | 15,762,582 | 60,746,015 |
| Ugagak..... | 902,728 | 897,767 | 1,216,252 | 1,578,862 | 1,856,600 | 6,452,209 |
| Ugashik..... | 577,615 | 254,716 | 569,076 | 647,422 | 1,047,111 | 3,035,940 |
| Total..... | 20,581,326 | 20,195,107 | 14,786,678 | 17,593,287 | 24,513,532 | 97,669,930 |
| King salmon: | | | | | | |
| Nushagak..... | 67,622 | 89,599 | 116,281 | 81,591 | 73,639 | 428,932 |
| Igushik..... | 34 | 94 | 106 | 330 | 477 | 1,041 |
| Kvichak-Naknek..... | 5,648 | 10,657 | 29,392 | 20,994 | 16,155 | 82,786 |
| Ugagak..... | 254 | 405 | 510 | 365 | 143 | 1,577 |
| Ugashik..... | 691 | 1,209 | 1,739 | 1,904 | 531 | 6,074 |
| Total..... | 74,249 | 101,961 | 148,028 | 105,124 | 91,145 | 520,510 |
| Coho salmon: | | | | | | |
| Nushagak..... | 66,640 | 81,434 | 117,172 | 293,210 | 62,260 | 620,716 |
| Kvichak-Naknek..... | 2 | 17,462 | 13,271 | 288 | 3 | 31,026 |
| Ugagak..... | 165 | 165 | | | | 330 |
| Total..... | 66,807 | 99,061 | 130,443 | 293,498 | 62,263 | 652,072 |
| Pink and chum salmon: | | | | | | |
| Nushagak..... | 683,201 | 932,477 | 444,146 | 1,818,566 | 303,437 | 4,181,827 |
| Igushik..... | | | | 738 | 183 | 921 |
| Kvichak-Naknek..... | 13,940 | 173,831 | 232,082 | 304,117 | 83,019 | 806,989 |
| Ugagak..... | 7,450 | 7,450 | 12,004 | 7,500 | 5,726 | 40,130 |
| Ugashik..... | 14,704 | 14,613 | 18,212 | 49,196 | 879 | 97,604 |
| Total..... | 719,295 | 1,128,371 | 706,444 | 2,180,117 | 393,244 | 5,127,471 |
| Grand total..... | 21,441,677 | 21,524,503 | 15,771,593 | 20,172,026 | 25,069,184 | 103,969,983 |

^a From "Alaska Fisheries and Fur Industries in 1917," p. 32. By Ward T. Bower and Henry D. Aller. Appendix II, Report, U. S. Commissioner of Fisheries, 1917. Washington, 1918.

PACK OF CANNED SALMON IN 1919.

The following table shows, by species, grades, and sizes, the pack of canned salmon for the Pacific coast of North America in 1919:

PACK OF CANNED SALMON ON THE PACIFIC COAST IN 1919.^a

| Species, grades, and sizes. | Alaska. | Puget Sound. | Hoh River. | Queets River. | Quinalt River. | Grays Harbor. | Willapa Harbor. | Columbia River. |
|-------------------------------------|------------------|------------------|---------------|---------------|----------------|---------------|-----------------|-----------------|
| Coho, silver, or medium red: | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> |
| ½-pound flat..... | 10,087 | 15,640 | ..... | 175 | ..... | 2,548 | ..... | 14,387 |
| 1-pound flat..... | 10,357 | 32,936 | ..... | ..... | ..... | 2,167 | ..... | 27,471 |
| 1-pound tall..... | 209,694 | 162,307 | 233 | 850 | 775 | 7,499 | 2,927 | 48,870 |
| Total..... | 230,138 | 210,883 | 233 | 1,025 | 775 | 12,214 | 2,927 | 90,728 |
| Chinook or king, red: | | | | | | | | |
| Fancy— | | | | | | | | |
| ½-pound flat..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 143,558 |
| 1-pound flat..... | 8,323 | ..... | ..... | ..... | ..... | ..... | ..... | 130,056 |
| 1-pound tall..... | 20,259 | ..... | ..... | ..... | ..... | ..... | ..... | 38,749 |
| Standard— | | | | | | | | |
| ½-pound flat..... | 7,422 | 21,685 | ..... | 450 | ..... | 1,454 | ..... | 24,279 |
| 1-pound flat..... | 2,961 | 8,398 | ..... | ..... | ..... | 506 | ..... | 25,038 |
| 1-pound tall..... | 112,768 | 35,874 | ..... | ..... | 165 | 2,410 | 1,152 | 30,445 |
| Total..... | 151,733 | 65,957 | ..... | 450 | 165 | 4,370 | 1,152 | 392,125 |
| Chinook or king, white: | | | | | | | | |
| ½-pound flat..... | ..... | 172 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1-pound tall..... | ..... | 2,413 | ..... | ..... | ..... | ..... | ..... | ..... |
| Total..... | ..... | 2,585 | ..... | ..... | ..... | ..... | ..... | ..... |
| Chum or keta: | | | | | | | | |
| ½-pound flat..... | 3,846 | 3,403 | ..... | ..... | ..... | 6 | ..... | 3,018 |
| 1-pound flat..... | ..... | 3,242 | ..... | ..... | ..... | 2,739 | ..... | 2,129 |
| 1-pound tall..... | 1,344,616 | 518,896 | 332 | 50 | 650 | 25,967 | 9,125 | 70,346 |
| Total..... | 1,348,462 | 525,541 | 332 | 50 | 650 | 28,712 | 9,125 | 75,493 |
| Humpback or pink: | | | | | | | | |
| ½-pound flat..... | 27,776 | 17,379 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1-pound flat..... | 7,548 | 41,574 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1-pound tall..... | 1,622,110 | 362,262 | 18 | ..... | ..... | ..... | ..... | ..... |
| Total..... | 1,657,434 | 421,215 | 18 | ..... | ..... | ..... | ..... | ..... |
| Sockeye or red: | | | | | | | | |
| ½-pound flat..... | 116,205 | 43,556 | ..... | 100 | 1,144 | ..... | ..... | 7,268 |
| 1-pound flat..... | 109,933 | 13,688 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1-pound tall..... | 978,205 | 7,102 | ..... | ..... | ..... | ..... | ..... | ..... |
| Total..... | 1,204,343 | 64,346 | ..... | 100 | 1,144 | ..... | ..... | 7,268 |
| Steelhead trout: | | | | | | | | |
| ½-pound flat..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 7,212 |
| 1-pound flat..... | ..... | 5,099 | ..... | ..... | ..... | ..... | ..... | 5,896 |
| 1-pound tall..... | 91 | ..... | ..... | ..... | ..... | ..... | ..... | 1,306 |
| Total..... | 91 | 5,099 | ..... | ..... | ..... | ..... | ..... | 14,414 |
| Grand total..... | 4,592,201 | 1,295,626 | 583 | 1,625 | 2,734 | 45,296 | 13,204 | 580,028 |

^a Reduced to a common basis of forty-eight 1-pound cans to the case.

PACK OF CANNED SALMON ON THE PACIFIC COAST IN 1919—Continued.

| Species, grades, and sizes. | Nehalem River. | Tillamook Bay. | Nes-tugga River. | Alsea Bay and River. | Siletz River. | Sius-law River. | Umpqua River. | Coquille River. |
|------------------------------|----------------|----------------|------------------|----------------------|---------------|-----------------|---------------|-----------------|
| Coho, silver, or medium red: | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. |
| ½-pound flat..... | | 4,000 | 300 | 1,658 | 300 | | | 1,364 |
| 1-pound flat..... | | | 100 | 525 | 200 | | | |
| 1-pound tall..... | 8,124 | 3,150 | 2,000 | 424 | 5,392 | 3,760 | 7,500 | 3,646 |
| Total..... | 8,124 | 7,150 | 2,400 | 2,607 | 5,892 | 3,760 | 7,500 | 5,010 |
| Chinook or king, red: | | | | | | | | |
| Standard— | | | | | | | | |
| ½-pound flat..... | | 1,000 | 1,500 | 1,157 | 500 | | | 1,027 |
| 1-pound flat..... | | | 100 | 100 | 19 | | | |
| 1-pound tall..... | 500 | 500 | 300 | 1,255 | 874 | | | |
| Total..... | 500 | 1,500 | 1,900 | 2,512 | 1,393 | | | 1,027 |
| Chum or keta: | | | | | | | | |
| ½-pound flat..... | | 3,150 | 50 | 50 | | | | |
| 1-pound tall..... | 1,183 | 1,200 | 400 | 485 | 472 | | | 45 |
| Total..... | 1,183 | 4,350 | 450 | 535 | 472 | | | 45 |
| Grand total..... | 9,807 | 13,000 | 4,750 | 5,654 | 7,757 | 3,760 | 7,500 | 6,082 |

| Species, grades, and sizes. | Rogue River. | Smith River. | Klamath River. | Sacramento River. | Noyo River. | Monte-rey Bay. | British Colum-bia. | Total. |
|------------------------------|--------------|--------------|----------------|-------------------|-------------|----------------|--------------------|-----------|
| Coho, silver, or medium red: | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. |
| ½-pound flat..... | 227 | | 625 | | | | 92,890 | 144,201 |
| 1-pound flat..... | 444 | | 520 | | | | 5,201 | 79,921 |
| 1-pound tall..... | | | | | | | 101,902 | 569,053 |
| Total..... | 671 | | 1,145 | | | | 199,993 | 793,175 |
| Chinook or king, red: | | | | | | | | |
| Fancy— | | | | | | | | |
| ½-pound flat..... | 4,000 | | | | | | | 147,558 |
| 1-pound flat..... | 3,000 | | | | | | | 141,379 |
| 1-pound tall..... | 1,580 | | | | | | | 60,588 |
| Standard— | | | | | | | | |
| ½-pound flat..... | 4,710 | 4,271 | 1,870 | | 4,500 | | 45,726 | 121,551 |
| 1-pound flat..... | 3,947 | 95 | 4,421 | 401 | 3,000 | | 2,892 | 51,878 |
| 1-pound tall..... | | | | 768 | | 2,000 | 33,638 | 222,649 |
| Total..... | 17,237 | 4,366 | 6,291 | 1,169 | 7,500 | 2,000 | 82,256 | 745,603 |
| Chinook or king, white: | | | | | | | | |
| ½-pound flat..... | | | | | | | 4,016 | 4,188 |
| 1-pound flat..... | | | | | | | 346 | 346 |
| 1-pound tall..... | | | | | | | 13,933 | 16,346 |
| Total..... | | | | | | | 18,295 | 20,880 |
| Chum or keta: | | | | | | | | |
| ½-pound flat..... | | | | | | | 49,257 | 62,780 |
| 1-pound flat..... | | | | | | | 11,984 | 20,094 |
| 1-pound tall..... | | | | | | | 310,794 | 2,284,561 |
| Total..... | | | | | | | 372,035 | 2,367,435 |
| Humpback or pink: | | | | | | | | |
| ½-pound flat..... | | | | | | | 127,435 | 172,590 |
| 1-pound flat..... | | | | | | | 14,839 | 63,961 |
| 1-pound tall..... | | | | | | | 204,365 | 2,188,755 |
| Total..... | | | | | | | 346,639 | 2,425,306 |
| Sockeye or red: | | | | | | | | |
| ½-pound flat..... | | | | | | | 293,720 | 461,993 |
| 1-pound flat..... | | | | | | | 13,339 | 136,960 |
| 1-pound tall..... | | | | | | | 59,945 | 1,015,252 |
| ½-pound oval..... | | | | | | | 1,941 | 1,941 |
| 1-pound oval..... | | | | | | | 500 | 500 |
| Total..... | | | | | | | 369,445 | 1,616,646 |
| Steelhead trout: | | | | | | | | |
| ½-pound flat..... | | | 145 | | | | 3,586 | 10,943 |
| 1-pound flat..... | | | 150 | | | | 116 | 11,261 |
| 1-pound tall..... | | | | | | | 791 | 2,188 |
| Total..... | | | 295 | | | | 4,493 | 21,392 |
| Grand total..... | 17,908 | 4,366 | 7,731 | 1,169 | 7,500 | 2,000 | 1,393,156 | 8,023,437 |

CANNING INDUSTRY, 1864 TO 1919.

SUMMARY OF CANNING INDUSTRY.

From the beginning of the canning of salmon on this coast it has been the most important branch of the industry, and the following table shows in condensed form the number of cases packed in each year on the Pacific coast of North America from the beginning of the industry in 1864 to 1919, both inclusive.

As British Columbia is a Province of the Dominion of Canada it does not come strictly within the scope of this report, but in order to show the pack of canned salmon on the North American shores of the Pacific Ocean, which would be incomplete without that of the Province, it has been included also.

PACK OF CANNED SALMON ON THE PACIFIC COAST, BY YEARS AND WATERS.

| Year. | Puget Sound. | Coastal streams of Washington. | Grays Harbor. | Willapa Harbor. | Columbia River. | Coastal streams of Oregon. | Smith River, Calif. |
|-------|--------------|--------------------------------|---------------|-----------------|-----------------|----------------------------|---------------------|
| | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. |
| 1866 | | | | | 4,000 | | |
| 1867 | | | | | 18,000 | | |
| 1868 | | | | | 28,000 | | |
| 1869 | | | | | 100,000 | | |
| 1870 | | | | | 150,000 | | |
| 1871 | | | | | 200,000 | | |
| 1872 | | | | | 250,000 | | |
| 1873 | | | | | 250,000 | | |
| 1874 | | | | | 350,000 | | |
| 1875 | | | | | 375,000 | | |
| 1876 | | | | | 450,000 | | |
| 1877 | 5,500 | | | | 380,000 | 7,804 | |
| 1878 | 238 | | 5,420 | | 460,000 | 26,934 | 4,277 |
| 1879 | 1,300 | | | | 480,000 | 8,571 | |
| 1880 | 5,100 | | | | 530,000 | 7,772 | 7,540 |
| 1881 | 5,500 | | | | 550,000 | 12,320 | |
| 1882 | 7,300 | | | | 541,300 | 19,186 | |
| 1883 | 1,500 | | | | 629,400 | 23,156 | |
| 1884 | 5,500 | | | | 620,000 | 27,876 | 5,540 |
| 1885 | 12,000 | | 8,200 | | 553,800 | 33,410 | 1,550 |
| 1886 | 17,000 | | 18,700 | 13,600 | 448,500 | 77,547 | |
| 1887 | 22,600 | | | | 350,000 | 73,996 | |
| 1888 | 21,975 | | 37,000 | 22,500 | 372,477 | 92,863 | 2,347 |
| 1889 | 11,674 | | | | 309,885 | 98,800 | |
| 1890 | 8,000 | | | | 435,774 | 47,009 | |
| 1891 | 20,529 | | 500 | 8,000 | 398,953 | 24,500 | |
| 1892 | 26,426 | | 16,500 | 14,500 | 487,338 | 83,000 | |
| 1893 | 89,774 | | 22,000 | 16,195 | 415,876 | 52,778 | 2,000 |
| 1894 | 95,400 | | 21,400 | 15,100 | 490,100 | 54,815 | 2,000 |
| 1895 | 179,968 | | 11,449 | 22,600 | 634,696 | 77,878 | 2,250 |
| 1896 | 195,664 | | 21,274 | 24,941 | 481,697 | 91,860 | |
| 1897 | 491,026 | | 13,300 | 29,600 | 552,721 | 68,683 | |
| 1898 | 400,200 | | 12,100 | 21,420 | 487,944 | 83,209 | |
| 1899 | 919,611 | | 24,240 | 21,314 | 332,774 | 82,041 | |
| 1900 | 469,450 | | 30,500 | 26,300 | 358,772 | 12,237 | |
| 1901 | 1,380,590 | | 41,500 | 34,000 | 390,183 | 58,618 | |
| 1902 | 581,659 | | 31,500 | 39,492 | 317,143 | 44,236 | |
| 1903 | 478,488 | | | 5,890 | 339,577 | 54,861 | |
| 1904 | 291,488 | | 27,559 | 26,400 | 395,104 | 98,874 | |
| 1905 | 1,018,641 | | 22,050 | 14,950 | 397,273 | 89,055 | |
| 1906 | 430,602 | | 22,000 | 14,440 | 394,898 | 107,332 | |
| 1907 | 698,080 | | 14,000 | 13,382 | 324,171 | 79,712 | |
| 1908 | 448,765 | | 14,000 | 20,457 | 277,719 | 83,994 | |
| 1909 | 1,678,737 | | 21,436 | 12,024 | 274,196 | 58,169 | |
| 1910 | 567,883 | | 55,480 | 11,508 | 391,415 | 104,617 | |
| 1911 | 1,551,028 | 18,431 | 75,941 | 25,497 | 553,331 | 138,146 | |
| 1912 | 416,119 | 19,914 | 47,287 | 28,148 | 286,026 | 84,074 | |
| 1913 | 2,583,403 | 13,121 | 19,895 | 12,050 | 266,479 | 38,492 | |
| 1914 | 817,354 | 21,459 | 32,434 | 16,837 | 454,621 | 106,617 | 3,000 |
| 1915 | 1,269,206 | 31,735 | 40,992 | 12,842 | 558,534 | 80,499 | 3,033 |
| 1916 | 1,652,917 | 15,777 | 60,336 | 18,553 | 517,861 | 81,924 | 2,505 |
| 1917 | 1,990,258 | 13,324 | 42,696 | 8,379 | 553,316 | 84,175 | 6,300 |
| 1918 | 622,732 | 13,732 | 35,972 | 8,827 | 591,381 | 92,241 | 4,653 |
| 1919 | 1,295,626 | 4,942 | 45,296 | 13,204 | 580,028 | 76,218 | 4,366 |
| Total | 22,192,871 | 152,438 | 893,257 | 572,950 | 21,376,293 | 2,750,999 | 51,281 |

PACK OF CANNED SALMON ON THE PACIFIC COAST, BY YEARS AND WATERS—CON.

| Year. | Klamath River, Calif. | Eel River, Calif. | Noyo River, Calif. | Sacramento River. | Alaska. | British Columbia. | Total. |
|------------|--------------------------|----------------------|-----------------------|----------------------|------------|----------------------|---------------------|
| | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. | Cases. ^a |
| 1864..... | | | | 2,000 | | | 2,000 |
| 1865..... | | | | 2,000 | | | 2,000 |
| 1866..... | | | | | | | 4,000 |
| 1867..... | | | | | | | 18,000 |
| 1868..... | | | | | | | 25,000 |
| 1869..... | | | | | | | 100,000 |
| 1870..... | | | | | | | 150,000 |
| 1871..... | | | | | | | 200,000 |
| 1872..... | | | | | | | 250,000 |
| 1873..... | | | | | | | 250,000 |
| 1874..... | | | | 2,500 | | | 352,500 |
| 1875..... | | | | 3,000 | | | 375,000 |
| 1876..... | | | | 10,000 | | 7,247 | 407,247 |
| 1877..... | | | | 21,500 | | 58,387 | 481,691 |
| 1878..... | | 8,590 | | 34,017 | 8,159 | 89,946 | 639,491 |
| 1879..... | | 10,500 | | 13,855 | 12,530 | 61,093 | 577,349 |
| 1880..... | | | | 62,000 | 6,539 | 61,849 | 687,010 |
| 1881..... | | 6,250 | | 181,200 | 8,977 | 169,576 | 930,573 |
| 1882..... | | | | 200,000 | 21,745 | 240,461 | 1,030,592 |
| 1883..... | | 15,000 | | 124,000 | 48,337 | 163,438 | 1,003,831 |
| 1884..... | | 8,200 | | 81,450 | 64,886 | 123,706 | 937,118 |
| 1885..... | | 5,750 | | 90,000 | 83,415 | 108,517 | 896,642 |
| 1886..... | | 12,500 | | 39,300 | 142,065 | 152,964 | 922,176 |
| 1887..... | | | | 36,500 | 206,677 | 204,083 | 899,256 |
| 1888..... | 4,100 | | | 68,075 | 412,115 | 184,040 | 1,217,792 |
| 1889..... | | | | 57,300 | 719,196 | 417,211 | 1,614,066 |
| 1890..... | | | | 25,065 | 682,591 | 411,257 | 1,609,696 |
| 1891..... | | | | 10,353 | 801,400 | 314,511 | 1,578,746 |
| 1892..... | 1,047 | | | 2,281 | 474,717 | 248,721 | 1,355,130 |
| 1893..... | 1,000 | | | 23,336 | 643,654 | 610,202 | 1,877,415 |
| 1894..... | 1,700 | | | 28,463 | 686,440 | 492,232 | 1,887,650 |
| 1895..... | 1,000 | | | 25,185 | 626,530 | 587,692 | 2,169,848 |
| 1896..... | | | | 13,387 | 966,707 | 617,782 | 2,413,312 |
| 1897..... | | | | 38,543 | 909,078 | 1,027,183 | 3,133,134 |
| 1898..... | | | | 29,731 | 965,097 | 492,551 | 2,492,252 |
| 1899..... | 1,000 | | | 32,580 | 1,078,146 | 785,519 | 3,257,825 |
| 1900..... | | | | 39,304 | 1,548,139 | 606,540 | 3,091,542 |
| 1901..... | | | | 17,500 | 2,016,804 | 1,247,212 | 5,180,407 |
| 1902..... | 2,500 | | | 14,043 | 2,536,824 | 627,161 | 4,194,558 |
| 1903..... | | | | 8,200 | 2,246,210 | 473,674 | 3,606,900 |
| 1904..... | 3,100 | | | 14,407 | 1,953,756 | 465,894 | 3,276,882 |
| 1905..... | | | | 2,780 | 1,894,516 | 1,167,460 | 4,606,725 |
| 1906..... | | | | | 2,219,044 | 629,460 | 3,817,776 |
| 1907..... | | | | | 2,169,873 | 547,459 | 3,846,677 |
| 1908..... | | | | | 2,618,048 | 542,689 | 4,005,672 |
| 1909..... | 5,633 | | | | 2,395,477 | 967,920 | 5,413,592 |
| 1910..... | 8,016 | 6,000 | | | 2,413,054 | 762,201 | 4,320,174 |
| 1911..... | 7,604 | 8,400 | | 4,142 | 2,823,817 | 948,965 | 6,155,302 |
| 1912..... | 18,000 | 11,000 | | | 4,054,641 | 996,576 | 5,961,785 |
| 1913..... | 6,376 | | | 950 | 3,739,185 | 1,353,901 | 8,033,915 |
| 1914..... | 11,000 | | | 17,315 | 4,056,653 | 1,111,039 | 6,648,329 |
| 1915..... | 12,900 | | | 66,179 | 4,500,293 | 1,133,381 | 7,649,594 |
| 1916..... | 8,884 | | | 19,445 | 4,900,627 | 995,065 | 7,703,894 |
| 1917..... | 8,630 | | | 11,413 | 5,947,286 | 1,657,485 | 10,223,022 |
| 1918..... | 10,200 | | 2,000 | 4,036 | 6,605,835 | 1,610,157 | 9,607,766 |
| 1919..... | 7,731 | | 7,500 | 43,169 | 4,592,201 | 1,393,156 | 8,023,437 |
| Total..... | 122,221 | 92,100 | 9,500 | 1,419,534 | 74,831,284 | 26,753,563 | 151,188,291 |

^a Reduced to a common basis of forty-eight 1-pound cans to the case.^b Includes 950 cases packed at Monterey.^c Includes 12,809 cases packed at Monterey.^d Includes 2,000 cases packed at Monterey.

CANNING INDUSTRY, BY SPECIES AND WATERS.

The tables which follow show separately, by waters and as far as possible by species, the salmon canned on the Pacific coast from the beginning of the industry until 1919. It is only within recent years that the published statistics have shown the pack of the different species separately. In the early years of canning the chinook, or quinnat, salmon was used exclusively, the other species not being utilized until the chinook had begun to decrease in abundance, or a demand

had arisen for a cheaper product. There is a very great difference in the selling value of the highest and lowest grades, and it is necessary to have complete statistical data now in order intelligently to comprehend the trend of the industry. While every effort has been made to make these tables complete, there are, unfortunately, some gaps which it was found impossible to fill. Such ellipses indicate that either the canneries did not operate or that no data were available for such periods.

Although there are only five species of salmon found on the Pacific coast, each bears several common names which are in general use in one or more of the many fishing districts. Trade names of each species as known in each district follow:

| Districts. | 1 | 2 | 3 | 4 | 5 |
|-----------------------|---------------|--------------|-------------------------------------|--------------------|-------|
| Alaska..... | Red..... | King..... | Coho..... Medium Red. Silver. | Pink..... | Chum. |
| British Columbia..... | Sockeye..... | Spring..... | Coho..... | Humpback..... | Keta. |
| Puget Sound..... | do..... | Tyee Spring | do..... | do..... | Chum. |
| Columbia River..... | Blueback..... | Chinook..... | Silverside..... | (None packed)..... | Do. |
| Outside rivers..... | Quinault..... | Quinnat..... | do..... | do..... | Do. |

PACK OF CANNED SALMON ON PUGET SOUND IN SPECIFIED YEARS.

| Year. | Can- neries oper- ated. | Chinook. | | Sockeye. | | Medium red or silver. | |
|-----------|----------------------------------|----------|---------|-----------|------------|--------------------------|-----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1877..... | 1 | | | | | 5,000 | ..... |
| 1878..... | 1 | | | | | 238 | ..... |
| 1879..... | 1 | | | | | 1,300 | \$5,690 |
| 1880..... | 1 | | | | | | |
| 1881..... | 1 | | | | | | |
| 1882..... | 1 | | | | | | |
| 1883..... | 1 | | | | | | |
| 1884..... | 1 | | | | | | |
| 1885..... | 4 | | | | | | |
| 1889..... | 2 | 240 | \$1,200 | | | 7,480 | 37,400 |
| 1890..... | 1 | 1,000 | 5,000 | | | 3,000 | 15,000 |
| 1891..... | 2 | 382 | 2,101 | 5,538 | \$21,921 | 5,869 | 19,308 |
| 1892..... | 2 | 86 | 473 | 2,954 | 11,816 | 7,276 | 24,500 |
| 1893..... | 3 | 1,200 | 6,480 | 47,852 | 103,371 | 11,812 | 59,000 |
| 1894..... | 3 | | | 41,781 | 188,014 | 22,418 | 89,672 |
| 1895..... | 7 | 1,542 | 7,325 | 65,143 | 273,108 | 50,865 | 154,218 |
| 1896..... | 11 | 13,495 | 67,475 | 72,979 | 350,299 | 82,640 | 264,448 |
| 1897..... | 12 | 9,500 | 39,045 | 312,048 | 1,248,192 | 91,900 | 282,133 |
| 1898..... | 18 | 11,200 | 50,624 | 252,000 | 1,058,400 | 98,600 | 335,210 |
| 1899..... | 19 | 24,364 | 103,180 | 499,646 | 2,368,334 | 111,387 | 418,176 |
| 1900..... | 19 | 22,350 | 134,100 | 229,800 | 1,149,000 | 128,200 | 512,800 |
| 1901..... | | | | 1,220,000 | | | |
| 1902..... | 21 | 30,049 | 150,245 | 372,301 | 2,047,655 | 85,817 | 429,085 |
| 1903..... | 22 | 14,500 | 72,500 | 167,211 | 1,003,260 | 103,450 | 413,800 |
| 1904..... | 13 | 14,441 | 69,352 | 109,264 | 653,871 | 118,127 | 447,851 |
| 1905..... | 24 | 1,804 | 9,922 | 825,453 | 4,952,718 | 79,335 | 337,174 |
| 1906..... | 16 | 8,139 | 48,834 | 178,748 | 1,251,236 | 91,497 | 472,485 |
| 1907..... | 14 | 1,814 | 10,326 | 93,122 | 698,416 | 119,472 | 476,288 |
| 1908..... | 11 | 95,210 | 666,470 | 170,951 | 1,196,657 | 128,922 | 644,922 |
| 1909..... | 24 | 13,019 | 72,604 | 1,097,904 | 6,183,300 | 143,133 | 630,446 |
| 1910..... | 15 | 10,064 | 60,324 | 248,014 | 1,673,095 | 162,755 | 895,153 |
| 1911..... | 21 | 21,823 | 172,582 | 127,709 | 1,168,145 | 256,123 | 1,711,178 |
| 1912..... | 21 | 20,252 | 101,706 | 181,680 | 1,660,173 | 149,727 | 761,200 |
| 1913..... | 32 | 1,234 | 5,247 | 1,673,099 | 10,871,178 | 61,019 | 235,372 |
| 1914..... | 22 | 27,140 | 179,532 | 339,787 | 2,751,832 | 158,933 | 715,995 |
| 1915..... | 40 | 28,466 | 145,555 | 64,584 | 676,769 | 180,783 | 902,335 |
| 1916..... | 32 | 45,072 | 270,432 | 90,866 | 817,790 | 208,967 | 1,044,835 |
| 1917..... | 45 | 70,918 | 638,262 | 454,336 | 4,543,360 | 115,860 | 926,880 |
| 1918..... | 33 | 62,821 | 565,385 | 52,587 | 736,225 | 235,795 | 2,004,258 |
| 1919..... | 35 | 68,542 | 856,775 | 64,346 | 1,029,536 | a 210,883 | 2,529,996 |

a Includes 1,892 cases packed with reds brought from Alaska.

PACK OF CANNED SALMON ON PUGET SOUND IN SPECIFIED YEARS—Continued.

| Year. | Can- neries oper- ated. | Chum. | | Pink. | | Total. | |
|-----------|----------------------------------|---------|-----------|-----------|-----------|-------------|------------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1877..... | 1 | | | 500 | | 5,500 | |
| 1878..... | 1 | | | | | 238 | |
| 1879..... | 1 | | | | | 1,300 | \$5,690 |
| 1880..... | 1 | | | | | 5,100 | |
| 1881..... | 1 | | | | | 8,500 | |
| 1882..... | 1 | | | | | 7,900 | |
| 1883..... | 1 | | | | | 1,500 | |
| 1884..... | 1 | | | | | 5,500 | |
| 1885..... | | | | | | 12,000 | |
| 1886..... | | | | | | 17,000 | |
| 1887..... | | | | | | 22,000 | |
| 1888..... | 4 | | | | | 21,975 | 126,356 |
| 1889..... | 2 | 1,145 | \$3,435 | 2,809 | \$7,584 | 11,674 | 49,619 |
| 1890..... | 1 | 4,000 | 12,000 | | | 8,000 | 32,000 |
| 1891..... | 2 | 3,093 | 10,825 | 5,647 | 15,246 | 20,529 | 72,461 |
| 1892..... | 2 | 16,180 | 56,630 | | | 26,426 | 93,419 |
| 1893..... | 3 | 11,380 | 31,295 | 17,530 | 47,331 | 89,774 | 247,537 |
| 1894..... | 3 | 22,152 | 60,918 | 9,049 | 24,432 | 95,400 | 363,036 |
| 1895..... | 7 | 38,785 | 94,741 | 23,633 | 62,556 | 179,968 | 591,948 |
| 1896..... | 11 | 26,550 | 73,013 | | | 195,664 | 755,235 |
| 1897..... | 12 | 23,310 | 64,103 | 57,268 | 171,804 | 494,026 | 1,805,277 |
| 1898..... | 18 | 38,400 | 105,600 | | | 400,200 | 1,549,864 |
| 1899..... | 19 | 31,481 | 86,427 | 252,733 | 734,241 | 919,611 | 3,710,358 |
| 1900..... | 19 | 89,100 | 245,025 | | | 469,450 | 1,940,925 |
| 1901..... | | | | | | 1,380,590 | |
| 1902..... | 21 | 93,492 | 467,460 | | | 581,659 | 3,084,445 |
| 1903..... | 22 | 12,001 | 30,002 | 181,325 | 407,984 | 475,488 | 1,927,546 |
| 1904..... | 13 | 49,656 | 124,254 | | | 291,488 | 1,295,323 |
| 1905..... | 24 | 41,057 | 102,643 | 70,992 | 212,976 | 1,018,641 | 5,015,433 |
| 1906..... | 16 | 149,218 | 708,781 | | | 430,602 | 2,481,336 |
| 1907..... | 14 | 50,249 | 150,847 | 433,423 | 1,300,269 | 698,080 | 2,642,146 |
| 1908..... | 11 | 47,607 | 142,821 | 6,075 | 18,225 | 448,765 | 2,069,095 |
| 1909..... | 24 | 53,688 | 128,916 | 370,993 | 902,342 | 1,078,737 | 7,917,608 |
| 1910..... | 15 | 146,942 | 514,297 | 108 | 388 | 567,883 | 3,143,256 |
| 1911..... | 21 | 98,321 | 391,123 | 1,046,992 | 4,302,344 | 1,551,028 | 7,745,372 |
| 1912..... | 21 | 60,760 | 154,193 | 700 | 2,185 | 416,119 | 2,679,457 |
| 1913..... | 32 | 56,225 | 124,970 | 791,886 | 2,092,401 | 2,583,463 | 13,329,168 |
| 1914..... | 22 | 290,477 | 903,675 | 1,017 | 4,615 | 817,354 | 4,555,049 |
| 1915..... | 40 | 411,724 | 1,155,474 | 583,649 | 1,795,285 | 1,269,206 | 4,765,418 |
| 1916..... | 32 | 564,194 | 2,031,098 | 143,804 | 575,216 | a 1,052,917 | 4,739,455 |
| 1917..... | 45 | 218,977 | 1,270,067 | 1,130,163 | 6,780,978 | b 1,990,258 | 14,159,583 |
| 1918..... | 33 | 264,922 | 1,669,069 | 6,607 | 42,946 | 622,732 | 5,017,823 |
| 1919..... | 35 | 525,541 | 3,363,462 | 421,215 | 3,369,720 | c 1,295,626 | 11,149,489 |

a Includes 14 cases of steelheads, valued at \$84. The totals also include large quantities of salmon brought to the sound canneries from other waters, principally in British Columbia, and packed here, these when prepared for market comprising approximately 141,917 cases of humpbacks or pinks, valued at \$566,952; 136,316 cases of chums, valued at \$538,967, and 53,135 cases of silvers, valued at \$87,185: a grand total of 331,308 cases and \$1,193,074.

b Includes 4 cases of steelheads, valued at \$36.

c Includes 5,099 cases of steelheads from sound waters.

PACK OF CANNED SALMON ON SOLEDUCK RIVER, WASH., IN SPECIFIED YEARS.^a

| Year. | Canneries operated. | Chinook. | | Sockeye. | | Silverside. | |
|-----------|------------------------|----------|---------|----------|--------|-------------|---------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1912..... | 1 | 414 | \$2,484 | 15 | \$156 | 940 | \$4,324 |
| 1913..... | 1 | 206 | 1,442 | | | 1,040 | 3,536 |
| 1914..... | 1 | 237 | 1,185 | | | 1,439 | 5,574 |
| 1915..... | 1 | 388 | 1,940 | | | 1,320 | 6,072 |

| Year. | Canneries operated. | Pink. ^b | | Chum. | | Total. | |
|-----------|------------------------|--------------------|--------|--------|--------|--------|---------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1912..... | 1 | 103 | \$268 | 76 | \$182 | 1,548 | \$7,414 |
| 1913..... | 1 | | | 28 | 61 | 1,274 | 5,039 |
| 1914..... | 1 | 189 | 567 | 103 | 291 | 1,968 | 7,617 |
| 1915..... | 1 | 826 | 2,478 | 192 | 538 | 2,726 | 11,028 |

a None packed since 1915.

b These are virtually all light-colored chinooks.

PACK OF CANNED SALMON ON HOH RIVER, WASH., IN SPECIFIED YEARS.

| Year. | Canneries operated. | Chinook. | | Siverside. | | Chum. | | Total. | |
|-----------|---------------------|----------|---------|------------|---------|--------|--------|--------|---------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1917..... | 1 | 372 | \$3,348 | 204 | \$1,665 | 110 | \$715 | 686 | \$5,728 |
| 1918..... | 1 | 60 | 540 | 294 | 2,499 | 17 | 108 | 371 | 3,147 |
| 1919..... | 1 | 18 | 216 | 233 | 2,796 | 332 | 2,125 | 583 | 5,137 |

PACK OF CANNED SALMON ON QUEETS RIVER, WASH., IN SPECIFIED YEARS.

| Year. | Canneries operated. | Chinook. | | Sockeye. | | Siverside. | |
|-----------|---------------------|----------|---------|----------|---------|------------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1912..... | 1 | 750 | \$4,500 | 200 | \$2,080 | 2,500 | \$11,500 |
| 1913..... | 1 | 1,082 | 7,574 | 220 | 1,848 | 1,680 | 5,712 |
| 1914..... | 1 | 1,175 | 5,875 | 200 | 2,134 | 1,800 | 6,966 |
| 1915..... | 1 | 1,506 | 9,036 | 1,512 | 9,072 | 617 | 3,085 |
| 1916..... | 1 | 713 | 6,417 | ..... | ..... | 1,196 | 9,759 |
| 1917..... | 1 | 381 | 3,429 | 20 | 280 | 1,138 | 9,673 |
| 1918..... | 1 | 450 | 5,400 | 100 | 1,600 | 1,025 | 12,300 |

| Year. | Canneries operated. | Chum. | | Steelhead. | | Total. | |
|-----------|---------------------|--------|---------|------------|---------|--------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1912..... | 1 | 1,000 | \$2,400 | ..... | ..... | 4,450 | \$20,480 |
| 1913..... | 1 | 670 | 1,461 | 600 | \$3,300 | 4,252 | 19,895 |
| 1914..... | 1 | 1,020 | 2,887 | 500 | 2,750 | 4,695 | 20,612 |
| 1915..... | 1 | 415 | 1,245 | ..... | ..... | 1,512 | 9,072 |
| 1916..... | 1 | 47 | 306 | 129 | 1,161 | 2,538 | 13,366 |
| 1917..... | 1 | ..... | ..... | a 87 | 870 | 2,085 | 17,643 |
| 1918..... | 1 | 50 | 320 | ..... | ..... | 1,626 | 14,252 |
| 1919..... | 1 | ..... | ..... | ..... | ..... | 1,625 | 19,620 |

a 68 cases of these were smoked.

PACK OF CANNED SALMON ON QUINULT RIVER, WASH., IN SPECIFIED YEARS.

| Year. | Canneries operated. | Chinook. | | Sockeye. | | Siverside. | |
|-------------------------|---------------------|----------|----------|----------|----------|------------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1911 ^a | 1 | 5,000 | \$35,000 | 2,031 | \$16,000 | 6,000 | \$42,000 |
| 1912..... | 2 | ..... | ..... | 4,500 | 40,500 | 3,916 | 18,014 |
| 1913..... | 1 | ..... | ..... | 492 | 4,133 | 7,106 | 24,160 |
| 1914..... | 2 | 51 | 255 | 12,074 | 120,740 | 1,623 | 6,281 |
| 1915..... | 2 | 1,144 | 6,864 | 22,972 | 239,989 | 1,388 | 6,807 |
| 1916..... | 2 | 1,365 | 8,190 | 10,315 | 92,835 | 1,093 | 5,465 |
| 1917..... | 2 | 309 | 2,781 | 4,608 | 55,296 | 2,609 | 21,289 |
| 1918..... | 2 | 1,497 | 13,473 | 2,470 | 30,869 | 6,086 | 51,731 |
| 1919..... | 2 | 165 | 2,063 | 1,144 | 18,304 | 775 | 9,300 |

| Year. | Canneries operated. | Chum. | | Total. | |
|-------------------------|---------------------|--------|----------|----------|-----------|
| | | Cases. | Value. | Cases. | Value. |
| 1911 ^a | 1 | 5,400 | \$27,000 | 18,431 | \$120,000 |
| 1912..... | 2 | 5,500 | 13,200 | 13,916 | 71,714 |
| 1913..... | 1 | ..... | ..... | 7,598 | 28,293 |
| 1914..... | 2 | 1,048 | 2,966 | 14,796 | 130,242 |
| 1915..... | 2 | 1,993 | 5,580 | 27,497 | 259,240 |
| 1916..... | 2 | 466 | 1,398 | 13,239 | 107,888 |
| 1917..... | 2 | 1,821 | 11,836 | b 10,553 | 98,438 |
| 1918..... | 2 | 1,682 | 10,874 | 11,735 | 106,947 |
| 1919..... | 2 | 650 | 4,160 | 2,734 | 33,827 |

^a Previous to this date the fish were transported to the Aberdeen and Hoquiam canneries and prepared there.^b Includes 1,206 cases of humpbacks, valued at \$7,236.

PACK OF CANNED SALMON ON GRAYS HARBOR IN SPECIFIED YEARS.

| Year. | Can-neries oper-ated. | Chinook. | | Siverside. | | Chum. | | Total. | |
|-------|-----------------------|----------|----------|------------|---------|----------|---------|----------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1878. | 1 | | | | | | | 5,420 | \$29,268 |
| 1879. | 1 | | | | | | | | |
| 1885. | | | | | | | | 8,300 | |
| 1886. | | | | | | | | 17,700 | |
| 1888. | 4 | | | | | | | 37,000 | 212,750 |
| 1891. | 1 | | | 500 | \$1,500 | | | 500 | 1,500 |
| 1892. | 1 | 4,500 | \$15,390 | 9,000 | 30,750 | 3,000 | \$9,415 | 16,500 | 55,585 |
| 1893. | 1 | 4,500 | 22,500 | 12,000 | 48,000 | 5,500 | 14,850 | 22,000 | 85,350 |
| 1894. | 1 | 12,300 | 61,500 | 4,100 | 16,400 | 5,000 | 13,500 | 21,400 | 91,400 |
| 1895. | 1 | 56 | 202 | 8,876 | 28,403 | 2,517 | 6,922 | 11,449 | 35,527 |
| 1896. | 2 | 7,816 | 36,806 | 9,278 | 29,689 | 4,180 | 11,495 | 21,274 | 57,990 |
| 1897. | 1 | 3,100 | 11,741 | 8,300 | 23,481 | 1,900 | 5,000 | 13,300 | 40,222 |
| 1898. | 2 | 5,100 | 23,052 | 4,800 | 16,320 | 2,200 | 6,050 | 12,100 | 45,422 |
| 1899. | 1 | 5,000 | 21,250 | 15,740 | 59,025 | 3,500 | 8,750 | 24,240 | 89,025 |
| 1900. | 2 | 6,700 | 33,500 | 12,900 | 51,600 | 11,200 | 30,800 | 30,800 | 115,900 |
| 1901. | | | | | | | | 41,500 | |
| 1902. | 1 | 4,000 | 20,000 | 10,000 | 45,000 | 17,500 | 70,000 | 31,500 | 135,000 |
| 1904. | 2 | 4,339 | 20,163 | 14,904 | 51,854 | 8,316 | 21,022 | 27,559 | 93,039 |
| 1905. | 2 | 2,050 | 9,225 | 13,000 | 52,000 | 7,000 | 18,200 | 22,050 | 79,425 |
| 1906. | 2 | 2,500 | 10,000 | 11,500 | 43,900 | 8,000 | 21,500 | 22,000 | 75,400 |
| 1907. | 1 | 1,000 | 7,000 | 9,500 | 47,500 | 3,500 | 11,500 | 14,000 | 66,000 |
| 1908. | 1 | 1,000 | 7,000 | 9,500 | 47,500 | 3,500 | 11,500 | 14,000 | 66,000 |
| 1909. | 1 | 5,721 | 20,819 | 9,019 | 38,146 | 5,047 | 11,608 | a 21,436 | 79,624 |
| 1910. | 3 | 15,495 | 90,718 | 21,768 | 108,840 | 13,867 | 48,534 | b 55,480 | 272,017 |
| 1911. | 4 | 15,773 | 110,411 | 28,991 | 202,937 | c 31,177 | 155,885 | 75,941 | 469,233 |
| 1912. | 5 | 9,060 | 54,360 | 26,162 | 120,345 | 12,065 | 28,956 | d 47,287 | 203,661 |
| 1913. | 4 | 1,258 | 8,771 | 5,723 | 19,458 | 12,919 | 28,163 | 19,805 | 56,302 |
| 1914. | 4 | 11,899 | 59,495 | 9,156 | 35,434 | 11,379 | 32,203 | 32,434 | 127,132 |
| 1915. | 4 | 4,219 | 20,089 | 14,036 | 61,707 | 22,737 | 63,678 | 40,992 | 145,474 |
| 1916. | 5 | 12,400 | 74,403 | 11,580 | 57,898 | 32,560 | 117,744 | d 60,336 | 265,229 |
| 1917. | 9 | 12,124 | 109,116 | 9,580 | 51,246 | 10,910 | 70,915 | e 42,696 | 291,715 |
| 1918. | 6 | 8,731 | 99,912 | 21,994 | 201,705 | 5,247 | 37,915 | 35,972 | 330,532 |
| 1919. | 6 | 4,370 | 54,026 | 12,214 | 140,608 | 28,712 | 183,757 | 45,296 | 384,991 |

a Includes 1,649 cases, valued at \$9,051, packed with sockeyes brought from Puget Sound.

b Includes 4,350 cases of "quinault," or sockeye, salmon, valued at \$23,925.

c Includes 6,730 cases of humpbacks.

d Includes 3,796 cases of humpbacks, valued at \$15,184.

e Includes 10,073 cases of humpbacks, valued at \$60,438.

PACK OF CANNED SALMON ON WILLAPA HARBOR IN SPECIFIED YEARS.

| Year. | Can-neries oper-ated. | Chinook or black. | | Siverside. | | Chum. | | Total. | |
|-------|-----------------------|-------------------|----------|------------|----------|--------|---------|----------|-----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1886. | | | | | | | | 13,600 | |
| 1887. | 4 | | | | | | | | |
| 1888. | 3 | | | | | | | 22,500 | \$129,375 |
| 1891. | 1 | | | 8,000 | \$21,000 | | | 8,000 | 21,000 |
| 1892. | 1 | 3,000 | \$10,260 | 9,000 | 30,750 | 2,500 | \$7,745 | 14,500 | 48,785 |
| 1893. | 1 | 1,700 | 9,180 | 7,895 | 31,580 | 6,600 | 18,150 | 16,195 | 58,910 |
| 1894. | 1 | 2,700 | 14,580 | 5,600 | 22,400 | 6,800 | 18,700 | 15,100 | 55,680 |
| 1895. | 2 | 4,636 | 23,180 | 13,047 | 41,150 | 4,917 | 13,222 | 22,600 | 77,552 |
| 1896. | 2 | 4,551 | 22,755 | 11,940 | 38,208 | 8,450 | 21,238 | 24,941 | 82,201 |
| 1897. | 1 | 8,100 | 33,291 | 14,600 | 44,822 | 6,900 | 18,975 | 29,600 | 97,088 |
| 1898. | 2 | 5,865 | 26,510 | 9,809 | 33,351 | 5,746 | 15,802 | 21,420 | 75,663 |
| 1899. | 3 | 5,650 | 25,425 | 10,675 | 40,031 | 4,989 | 13,720 | 21,314 | 79,176 |
| 1900. | 3 | 6,700 | 33,500 | 12,400 | 49,600 | 7,200 | 19,800 | 26,300 | 102,900 |
| 1901. | | | | | | | | 34,000 | |
| 1902. | 2 | 5,836 | 29,186 | 9,128 | 41,076 | 24,528 | 97,112 | 39,492 | 167,368 |
| 1903. | 1 | 2,300 | 13,800 | 2,390 | 10,755 | 1,200 | 3,300 | 5,890 | 27,855 |
| 1904. | 2 | 3,000 | 12,000 | 7,400 | 28,440 | 16,000 | 38,700 | 26,400 | 79,140 |
| 1905. | 2 | 4,650 | 20,925 | 4,300 | 17,200 | 6,000 | 15,000 | 14,950 | 53,125 |
| 1906. | 2 | 4,000 | 16,000 | 5,340 | 21,360 | 5,100 | 13,260 | 14,440 | 50,620 |
| 1907. | 2 | 3,530 | 15,354 | 9,228 | 36,682 | 624 | 2,496 | 13,382 | 54,532 |
| 1908. | 2 | 4,017 | 20,585 | 5,923 | 23,692 | 10,517 | 36,809 | 20,457 | 81,086 |
| 1909. | 1 | 1,455 | 5,869 | 4,822 | 17,359 | 5,747 | 13,163 | 12,024 | 36,391 |
| 1910. | 1 | 2,923 | 15,077 | 5,096 | 25,480 | 3,489 | 22,711 | 11,508 | 63,268 |
| 1911. | 2 | 5,717 | 40,019 | 9,298 | 65,086 | 10,482 | 52,410 | 25,497 | 157,515 |
| 1912. | 3 | 6,123 | 36,738 | 8,030 | 36,938 | 9,533 | 22,879 | a 28,148 | 108,156 |
| 1913. | 2 | 67 | 469 | 3,111 | 10,577 | 8,872 | 19,368 | 12,050 | 30,414 |
| 1914. | 3 | 2,924 | 14,431 | 7,179 | 27,749 | 6,734 | 19,077 | 16,837 | 61,256 |
| 1915. | 2 | 3,148 | 19,380 | 4,008 | 18,437 | 5,686 | 15,921 | 12,842 | 53,738 |
| 1916. | 2 | 5,115 | 30,680 | 3,365 | 16,825 | 10,073 | 36,262 | 18,553 | 83,777 |
| 1917. | 2 | 1,720 | 18,920 | 2,143 | 19,287 | 4,516 | 30,708 | 8,379 | 68,915 |
| 1918. | 2 | 921 | 10,131 | 6,249 | 50,390 | 2,657 | 18,599 | 8,827 | 70,120 |
| 1919. | 2 | 1,152 | 13,824 | 2,927 | 35,124 | 9,125 | 58,400 | 13,204 | 107,348 |

a Includes 4,462 cases of humpbacks, valued at \$11,601.

PACK OF CANNED SALMON ON THE COLUMBIA RIVER FROM THE INCEPTION OF THE INDUSTRY TO 1919.

| Year. | Canneries operated. | Chinook. | | Blueback. | | Siverside. | |
|-------|---------------------|----------|-----------|-----------|-----------|------------|-----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1866 | 1 | 4,000 | \$64,000 | | | | |
| 1867 | 1 | 18,000 | 288,000 | | | | |
| 1868 | 2 | 28,000 | 392,000 | | | | |
| 1869 | | 100,000 | 1,350,000 | | | | |
| 1870 | | 150,000 | 1,800,000 | | | | |
| 1871 | | 200,000 | 2,100,000 | | | | |
| 1872 | | 250,000 | 2,325,000 | | | | |
| 1873 | | 250,000 | 2,250,000 | | | | |
| 1874 | 13 | 350,000 | 2,625,000 | | | | |
| 1875 | 13 | 375,000 | 2,250,000 | | | | |
| 1876 | 17 | 450,000 | 2,475,000 | | | | |
| 1877 | | 380,000 | 2,052,000 | | | | |
| 1878 | 30 | 460,000 | 2,300,000 | | | | |
| 1879 | 30 | 480,000 | 2,640,000 | | | | |
| 1880 | 35 | 530,000 | 2,650,000 | | | | |
| 1881 | 35 | 550,000 | 2,475,000 | | | | |
| 1882 | | 541,300 | 2,600,000 | | | | |
| 1883 | | 629,400 | 3,147,000 | | | | |
| 1884 | | 620,000 | 2,915,000 | | | | |
| 1885 | | 553,800 | 2,500,000 | | | | |
| 1886 | 39 | 448,500 | 2,135,000 | | | | |
| 1887 | | 356,000 | 2,124,000 | | | | |
| 1888 | 28 | 372,477 | 2,327,981 | | | | |
| 1889 | 21 | 266,697 | 1,600,182 | 17,797 | \$101,051 | | |
| 1890 | 21 | 335,604 | 1,946,087 | 57,345 | 290,069 | | |
| 1891 | 22 | 353,907 | 2,038,566 | 15,482 | 284,242 | | |
| 1892 | 24 | 344,267 | 1,996,388 | 66,547 | 372,909 | 4,176 | \$20,880 |
| 1893 | 24 | 288,773 | 1,559,374 | 30,459 | 152,295 | 29,107 | 116,428 |
| 1894 | 24 | 351,106 | 1,895,976 | 43,814 | 224,430 | 42,758 | 171,032 |
| 1895 | 24 | 444,909 | 2,428,658 | 18,015 | 86,523 | 99,601 | 329,683 |
| 1896 | 24 | 370,943 | 1,840,511 | 16,983 | 81,518 | 44,108 | 141,145 |
| 1897 | 22 | 432,753 | 1,804,221 | 12,972 | 51,888 | 60,850 | 197,762 |
| 1898 | 23 | 329,566 | 1,490,394 | 66,670 | 300,015 | 65,431 | 222,465 |
| 1899 | 17 | 255,824 | 1,458,175 | 23,969 | 134,723 | 29,608 | 112,055 |
| 1900 | 16 | 262,392 | 1,821,258 | 13,162 | 92,184 | 44,925 | 202,163 |
| 1902 | 14 | 270,580 | 1,428,743 | 17,037 | 86,465 | 10,532 | 44,732 |
| 1903 | 16 | 301,762 | 1,610,614 | 8,383 | 42,867 | 12,181 | 49,869 |
| 1904 | 20 | 320,378 | 1,944,690 | 12,911 | 78,048 | 31,254 | 118,357 |
| 1905 | 19 | 327,106 | 1,962,636 | 7,768 | 46,608 | 26,826 | 114,011 |
| 1906 | 19 | 311,334 | 1,868,007 | 7,816 | 54,712 | 41,446 | 124,338 |
| 1907 | 19 | 258,433 | | 5,504 | | 31,757 | |
| 1908 | 14 | 210,096 | | 8,581 | | 31,432 | |
| 1909 | 15 | 162,131 | 1,203,546 | 27,908 | 214,561 | 42,178 | 185,070 |
| 1910 | 15 | 244,285 | 1,882,137 | 6,234 | 34,287 | 68,922 | 363,688 |
| 1911 | 15 | 405,862 | 2,204,185 | 5,988 | 47,904 | 79,416 | 549,478 |
| 1912 | 15 | 220,317 | 1,988,526 | 8,210 | 85,384 | 31,842 | 177,248 |
| 1913 | 15 | 192,116 | 1,664,670 | 11,152 | 93,677 | 40,969 | 175,412 |
| 1914 | 17 | 289,464 | 2,573,502 | 35,311 | 376,924 | 69,769 | 350,666 |
| 1915 | 19 | 406,486 | 3,694,361 | 5,459 | 56,707 | 33,336 | 173,234 |
| 1916 | 20 | 395,166 | 3,572,203 | 3,790 | 27,288 | 52,084 | 335,114 |
| 1917 | 20 | 403,637 | 5,023,529 | 7,968 | 111,552 | 64,299 | 700,680 |
| 1918 | 20 | 400,952 | 5,222,983 | 37,833 | 605,328 | 98,145 | 1,072,843 |
| 1919 | 21 | 392,125 | 5,031,207 | 7,268 | 73,116 | 90,728 | 1,052,767 |

α Of these, 2,846 cases, valued at \$23,203 were packed with sockeyes brought from Puget Sound.

PACK OF CANNED SALMON ON THE COLUMBIA RIVER FROM THE INCEPTION OF THE INDUSTRY TO 1919—Continued.

| Year. | Canneries operated. | Chum. | | Steelhead trout. | | Total. | |
|-----------|---------------------|--------|---------|------------------|-----------|-----------|-----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1866..... | 1 | | | | | 4,000 | \$64,000 |
| 1867..... | 1 | | | | | 18,000 | 288,000 |
| 1868..... | 2 | | | | | 28,000 | 392,000 |
| 1869..... | | | | | | 100,000 | 1,350,000 |
| 1870..... | | | | | | 150,000 | 1,800,000 |
| 1871..... | | | | | | 200,000 | 2,100,000 |
| 1872..... | | | | | | 250,000 | 2,325,000 |
| 1873..... | | | | | | 250,000 | 2,250,000 |
| 1874..... | 13 | | | | | 350,000 | 2,625,000 |
| 1875..... | 13 | | | | | 375,000 | 2,250,000 |
| 1876..... | | | | | | 450,000 | 2,475,000 |
| 1877..... | | | | | | 380,000 | 2,052,000 |
| 1878..... | 30 | | | | | 460,000 | 2,300,000 |
| 1879..... | 30 | | | | | 480,000 | 2,640,000 |
| 1880..... | 29 | | | | | 530,000 | 2,650,000 |
| 1881..... | 35 | | | | | 550,000 | 2,475,000 |
| 1882..... | | | | | | 541,300 | 2,600,000 |
| 1883..... | | | | | | 629,400 | 3,147,000 |
| 1884..... | | | | | | 620,000 | 2,915,000 |
| 1885..... | | | | | | 553,800 | 2,500,000 |
| 1886..... | 39 | | | | | 448,500 | 2,135,000 |
| 1887..... | | | | | | 356,000 | 2,124,000 |
| 1888..... | 28 | | | | | 372,477 | 2,372,981 |
| 1889..... | 21 | | | 25,391 | \$108,587 | 309,885 | 1,809,820 |
| 1890..... | 21 | | | 42,825 | 171,300 | 435,774 | 2,407,456 |
| 1891..... | 22 | | | 29,564 | 118,156 | 398,953 | 2,440,964 |
| 1892..... | 24 | | | 72,348 | 288,892 | 487,338 | 2,679,069 |
| 1893..... | 24 | 2,311 | \$6,933 | 65,226 | 260,904 | 415,876 | 2,095,934 |
| 1894..... | 24 | | | 52,422 | 209,688 | 490,100 | 2,501,126 |
| 1895..... | 21 | 22,493 | 62,591 | 49,678 | 203,542 | 634,696 | 3,110,997 |
| 1896..... | 24 | | | 49,663 | 198,652 | 481,697 | 2,261,826 |
| 1897..... | 22 | | | 46,146 | 165,440 | 552,721 | 2,219,311 |
| 1898..... | 23 | | | 26,277 | 60,352 | 487,944 | 2,073,226 |
| 1899..... | 17 | 11,379 | 33,836 | 11,994 | 39,186 | 332,774 | 1,777,975 |
| 1900..... | 16 | 17,696 | 63,706 | 20,597 | 102,985 | 358,772 | 2,282,296 |
| 1901..... | | | | | | 390,183 | 1,942,660 |
| 1902..... | 14 | 10,401 | 41,694 | 8,593 | 42,965 | 317,143 | 1,644,509 |
| 1903..... | 16 | 10,600 | 37,590 | 7,251 | 36,255 | 339,577 | 1,777,105 |
| 1904..... | 20 | 20,693 | 52,691 | 9,868 | 48,892 | 395,104 | 2,242,678 |
| 1905..... | 19 | 25,751 | 65,206 | 9,822 | 49,110 | 397,273 | 2,237,571 |
| 1906..... | 19 | 27,892 | 69,595 | 6,500 | 32,500 | 394,898 | 2,149,062 |
| 1907..... | 19 | 22,556 | | 5,921 | | 324,171 | 1,763,490 |
| 1908..... | 14 | 16,884 | | 10,726 | | 277,719 | 1,380,708 |
| 1909..... | 15 | 24,542 | 57,115 | 17,382 | 99,796 | a 274,196 | 1,760,220 |
| 1910..... | 15 | 66,538 | 232,883 | 5,436 | 31,203 | 391,415 | 2,544,198 |
| 1911..... | 15 | 53,471 | 203,198 | 8,594 | 47,399 | 553,331 | 3,052,164 |
| 1912..... | 15 | 18,699 | 46,590 | 6,958 | 22,108 | 286,926 | 2,319,856 |
| 1913..... | 15 | 13,303 | 29,486 | 8,939 | 49,142 | 266,479 | 2,012,387 |
| 1914..... | 17 | 49,285 | 305,541 | 10,792 | 59,356 | 444,621 | 3,695,989 |
| 1915..... | 19 | 86,530 | 251,632 | 26,723 | 129,358 | 558,534 | 4,305,292 |
| 1916..... | 20 | 77,766 | 307,483 | 18,999 | 118,987 | b 547,891 | 4,361,299 |
| 1917..... | 20 | 53,659 | 386,596 | 23,783 | 292,583 | 553,346 | 6,514,940 |
| 1918..... | 20 | 29,846 | 215,669 | 24,605 | 350,071 | 591,381 | 7,466,894 |
| 1919..... | 21 | 75,493 | 441,989 | 14,414 | 144,140 | 580,028 | 6,743,219 |

a Includes 55 cases of humpbacks, valued at \$432, packed with humpbacks brought from Puget Sound.

b Includes 56 cases of humpbacks, valued at \$224.

PACK OF CANNED SALMON ON THE COLUMBIA RIVER, BY STATES, 1916-1919.

| States and species. | 1916 | | 1917 | | 1918 | | 1919 | |
|---------------------|-----------------|-----------|---------|-----------|---------|-----------|----------------------|-----------|
| | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| Washington: | | | | | | | | |
| Blueback..... | 1,377 | \$12,389 | 2,801 | \$33,612 | 19,450 | \$245,070 | 2,329 | \$18,632 |
| Chinook..... | 179,083 | 1,074,495 | 146,140 | 1,753,680 | 145,511 | 1,715,874 | ^a 130,185 | 1,671,007 |
| Chum..... | 46,012 | 165,643 | 14,539 | 93,050 | 12,173 | 85,211 | 39,279 | 235,674 |
| Humpback..... | ^b 56 | 224 | | | | | | |
| Silverside..... | 26,788 | 133,940 | 15,989 | 183,874 | 35,746 | 343,162 | 34,927 | 349,270 |
| Steelhead..... | 14,348 | 86,091 | 6,053 | 66,583 | 8,699 | 104,388 | 7,148 | 71,480 |
| Total..... | 267,664 | 1,472,782 | 185,522 | 2,130,799 | 221,579 | 2,493,705 | 213,868 | 2,346,063 |
| Oregon: | | | | | | | | |
| Blueback..... | 2,413 | 14,899 | 5,167 | 77,940 | 18,383 | 360,258 | 4,939 | 54,484 |
| Chinook..... | 216,083 | 2,497,708 | 257,497 | 3,269,849 | 255,441 | 3,507,109 | 261,940 | 3,360,200 |
| Chum..... | 31,754 | 141,840 | 39,120 | 293,546 | 17,673 | 130,458 | 36,214 | 206,315 |
| Silverside..... | 25,206 | 201,174 | 48,310 | 516,806 | 62,339 | 729,681 | 55,801 | 703,497 |
| Steelhead..... | 4,651 | 32,896 | 17,730 | 225,955 | 15,906 | 245,683 | 7,266 | 72,660 |
| Total..... | 280,197 | 2,888,517 | 367,824 | 4,384,096 | 369,802 | 4,973,189 | 366,160 | 4,397,156 |
| Grand total.... | 547,861 | 4,361,299 | 553,346 | 6,514,895 | 591,381 | 7,466,894 | 580,028 | 6,743,219 |

^a Includes 106,328 cases spring chinooks, valued at \$1,382,264; 21,740 cases fall chinooks, valued at \$273,924; and 2,117 cases light-colored chinooks, valued at \$14,819.

^b Fish brought in from Puget Sound.

PACK OF CANNED SALMON ON NEHALEM RIVER, OREG., IN SPECIFIED YEARS.

| Year. | Can- neries oper- ated. | Chinook. | | Silverside. | | Chum. | | Total. | |
|-----------|----------------------------------|----------|---------|-------------|----------|--------|---------|--------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1887..... | 1 | | | | | | | 5,000 | \$30,000 |
| 1889..... | | | | | | | | 6,000 | 32,000 |
| 1890..... | | | | | | | | 9,000 | 45,500 |
| 1891..... | 1 | | | | | | | 3,500 | 14,000 |
| 1892..... | 1 | | | 10,000 | \$40,000 | | | 10,000 | 40,000 |
| 1893..... | 1 | 1,622 | \$6,768 | 5,031 | 20,124 | | | 6,723 | 26,892 |
| 1894..... | 1 | 1,627 | 6,508 | 4,866 | 19,464 | | | 6,493 | 25,972 |
| 1895..... | 1 | 1,752 | 7,008 | 5,152 | 16,486 | | | 6,904 | 23,494 |
| 1896..... | 1 | 2,828 | 8,484 | 5,218 | 15,654 | | | 8,046 | 24,138 |
| 1897..... | 2 | 3,384 | 10,152 | 8,366 | 25,098 | | | 11,750 | 35,250 |
| 1898..... | 1 | 3,808 | 9,891 | 5,700 | 19,380 | | | 9,508 | 29,271 |
| 1899..... | 1 | 1,384 | 5,536 | 7,405 | 26,658 | 1,288 | \$3,864 | 10,077 | 36,058 |
| 1900..... | 1 | | | | | | | | |
| 1901..... | 1 | 268 | 1,139 | 3,273 | 13,092 | 2,669 | 7,206 | 6,210 | 21,437 |
| 1902..... | 1 | 271 | 1,431 | 3,169 | 13,468 | 2,570 | 10,280 | 6,010 | 25,179 |
| 1903..... | 1 | 686 | 3,670 | 4,615 | 19,114 | | | 5,301 | 22,284 |
| 1904..... | 1 | 590 | 2,500 | 5,000 | 20,000 | 6,000 | 12,000 | 11,500 | 31,500 |
| 1905..... | 1 | 2,700 | 16,200 | 2,900 | 12,325 | 6,000 | 15,000 | 11,600 | 43,525 |
| 1906..... | 1 | 3,987 | 23,922 | 4,976 | 14,928 | 2,057 | 5,143 | 11,020 | 42,993 |
| 1907..... | 1 | 4,000 | 28,000 | 6,600 | 19,800 | 2,000 | 6,000 | 12,600 | 53,800 |
| 1908..... | 1 | 5,000 | 35,000 | 6,100 | 18,300 | 2,016 | 6,048 | 13,116 | 59,348 |
| 1909..... | 1 | 1,985 | 10,542 | 4,554 | 20,253 | 969 | 2,091 | 7,448 | 32,886 |
| 1910..... | 1 | 3,500 | 24,500 | 5,400 | 29,700 | 1,590 | 4,500 | 10,400 | 58,700 |
| 1911..... | 2 | 5,821 | 46,568 | 14,878 | 81,829 | 3,439 | 13,048 | 24,138 | 141,445 |
| 1912..... | 2 | | | 13,331 | 73,321 | 1,571 | 3,927 | 14,902 | 77,248 |
| 1913..... | 1 | 300 | 1,500 | 764 | 3,056 | 5 | 11 | 1,069 | 4,567 |
| 1914..... | 2 | 4,841 | 33,887 | 11,800 | 63,720 | 1,668 | 4,150 | 18,309 | 101,777 |
| 1915..... | 2 | 400 | 2,400 | 5,400 | 24,840 | 2,260 | 6,328 | 8,060 | 33,598 |
| 1916..... | 2 | 2,700 | 21,656 | 3,474 | 17,370 | 833 | 2,499 | 7,007 | 41,525 |
| 1917..... | 2 | 783 | 7,047 | 851 | 6,808 | 472 | 3,304 | 2,106 | 17,159 |
| 1918..... | 2 | 1,685 | 18,535 | 9,200 | 88,320 | 519 | 3,633 | 11,404 | 110,488 |
| 1919..... | 2 | 500 | 6,250 | 8,124 | 97,488 | 1,183 | 7,571 | 9,807 | 111,309 |

PACK OF CANNED SALMON ON TILLAMOOK BAY, OREG., IN SPECIFIED YEARS.

| Year. | Can- neries oper- ated. | Chinook. | | Silverside. | | Chum. | | Total. | |
|-------|----------------------------------|----------|---------|-------------|----------|--------|----------|--------|-----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1884 | | | | | | | | 4,500 | ..... |
| 1885 | | | | | | | | 9,800 | ..... |
| 1886 | 2 | | | | | | | 37,000 | ..... |
| 1887 | 2 | | | | | | | 21,000 | \$115,500 |
| 1888 | 2 | | | | | | | 14,633 | 84,140 |
| 1889 | | | | | | | | 9,500 | 52,250 |
| 1890 | | | | | | | | 14,009 | 79,049 |
| 1891 | 1 | | | | | | | | |
| 1892 | 1 | | | 18,000 | \$72,000 | | | 18,000 | 72,000 |
| 1893 | 1 | 497 | \$1,988 | 4,000 | 16,000 | 6,919 | \$17,297 | 11,416 | 35,285 |
| 1894 | 1 | 700 | 2,800 | 7,763 | 31,052 | 700 | 1,750 | 9,163 | 35,602 |
| 1895 | 1 | | | 6,514 | 20,845 | 7,001 | 19,253 | 13,515 | 40,098 |
| 1896 | 1 | 2,200 | 6,600 | 4,860 | 14,580 | | | 7,060 | 21,180 |
| 1897 | 1 | 2,000 | 6,000 | 9,000 | 27,000 | | | 11,000 | 33,000 |
| 1898 | 1 | 5,000 | 13,000 | 10,342 | 35,162 | | | 15,342 | 48,162 |
| 1899 | 1 | 2,180 | 8,720 | 3,889 | 14,036 | 5,121 | 15,363 | 11,190 | 38,119 |
| 1900 | 1 | | | | | | | | |
| 1901 | 1 | 848 | 4,240 | 2,133 | 9,598 | 3,901 | 10,728 | 6,882 | 24,566 |
| 1902 | 1 | 215 | 1,135 | 2,287 | 9,720 | 4,093 | 16,372 | 6,595 | 27,227 |
| 1903 | 1 | | | 2,727 | 11,590 | 2,620 | 10,480 | 5,347 | 22,070 |
| 1904 | 1 | | | 4,400 | 17,600 | 6,500 | 13,000 | 10,900 | 30,600 |
| 1905 | 1 | 1,100 | 6,600 | 1,700 | 7,650 | 8,800 | 22,000 | 11,600 | 36,250 |
| 1906 | 1 | 1,870 | 11,220 | 2,364 | 7,092 | 1,270 | 3,175 | 5,504 | 21,487 |
| 1907 | 1 | 2,000 | 14,000 | 3,410 | 10,230 | 2,314 | 6,942 | 7,724 | 31,172 |
| 1908 | 1 | 2,300 | 16,100 | 6,000 | 21,000 | 4,000 | 12,000 | 12,300 | 49,100 |
| 1909 | 1 | 2,615 | 15,663 | 5,029 | 21,809 | 3,712 | 8,538 | 11,356 | 46,010 |
| 1910 | 1 | 2,900 | 20,300 | 4,500 | 24,750 | 2,000 | 6,000 | 9,400 | 51,050 |
| 1911 | 2 | 8,433 | 67,464 | 12,663 | 69,047 | 5,277 | 20,053 | 26,373 | 157,164 |
| 1912 | 2 | 3,811 | 26,677 | 6,418 | 32,090 | 4,550 | 11,375 | 14,779 | 70,142 |
| 1913 | 1 | 2,600 | 15,600 | 1,000 | 4,000 | 1,000 | 2,200 | 4,600 | 21,800 |
| 1914 | 2 | 4,734 | 33,138 | 4,131 | 22,307 | 6,707 | 16,867 | 15,572 | 72,312 |
| 1915 | 3 | 5,675 | 34,300 | 4,549 | 20,925 | 9,099 | 25,477 | 19,323 | 70,702 |
| 1916 | 3 | 9,465 | 75,720 | 4,333 | 21,665 | 7,530 | 22,590 | 21,328 | 119,975 |
| 1917 | 3 | 8,822 | 79,398 | 5,522 | 44,176 | 6,941 | 48,587 | 21,285 | 172,161 |
| 1918 | 1 | 107 | 1,177 | 3,461 | 33,226 | 1,567 | 10,969 | 5,135 | 45,372 |
| 1919 | 2 | 1,500 | 18,750 | 7,150 | 85,800 | 4,350 | 27,840 | 13,000 | 132,390 |

PACK OF CANNED SALMON ON NESTUGGA RIVER, OREG., IN SPECIFIED YEARS.

| Year. | Can- neries oper- ated. | Chinook. | | Silverside. | | Chum. | | Total. | |
|-------|----------------------------------|----------|---------|-------------|----------|--------|---------|--------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1887 | 1 | | | | | | | 4,300 | \$23,650 |
| 1888 | 1 | | | | | | | 5,000 | 28,750 |
| 1889 | | | | | | | | 6,700 | 36,850 |
| 1890 | 1 | | | | | | | | |
| 1900 | 1 | 1,109 | \$1,436 | 3,034 | \$10,922 | 513 | \$1,539 | 4,656 | 16,897 |
| 1901 | 1 | 279 | 1,116 | 3,553 | 13,323 | 396 | 1,089 | 4,228 | 15,528 |
| 1905 | 1 | 3,000 | 18,000 | 1,000 | 4,250 | 400 | 1,000 | 4,400 | 23,250 |
| 1906 | 1 | 2,622 | 15,732 | 2,468 | 7,404 | 165 | 413 | 5,255 | 23,549 |
| 1907 | 1 | 2,100 | 14,700 | 3,540 | 10,620 | 150 | 450 | 5,790 | 23,770 |
| 1908 | 1 | 2,000 | 14,000 | 3,000 | 10,500 | 100 | 300 | 5,100 | 24,800 |
| 1910 | 1 | 2,000 | 14,000 | 3,300 | 18,150 | 140 | 420 | 5,440 | 32,570 |
| 1911 | 1 | 3,562 | 28,496 | 7,124 | 39,182 | 641 | 2,436 | 11,327 | 70,114 |
| 1912 | 1 | 3,090 | 18,540 | 6,180 | 30,900 | 708 | 1,770 | 9,978 | 51,210 |
| 1913 | 1 | 126 | 756 | 213 | 972 | | | 369 | 1,728 |
| 1914 | 1 | 3,542 | 24,794 | 5,730 | 30,942 | 265 | 662 | 9,537 | 56,308 |
| 1915 | 1 | 200 | 1,300 | 3,930 | 18,078 | 800 | 2,240 | 4,930 | 21,618 |
| 1916 | 1 | 2,400 | 19,200 | 4,036 | 20,280 | 200 | 600 | 6,656 | 40,800 |
| 1917 | 1 | 2,000 | 18,000 | 3,800 | 30,400 | 260 | 1,820 | 6,060 | 50,220 |
| 1918 | 1 | 3,000 | 33,000 | 3,206 | 30,778 | 215 | 1,505 | 6,421 | 65,283 |
| 1919 | 1 | 1,900 | 23,750 | 2,400 | 28,800 | 450 | 2,880 | 4,750 | 55,430 |

PACK OF CANNED SALMON ON SILETZ RIVER, OREG., IN SPECIFIED YEARS.

| Year. | Can- neries oper- ated. | Chinook. | | Silverside. | | Chum. | | Total. | |
|-----------|----------------------------------|----------|---------|-------------|---------|--------|--------|--------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1896..... | 1 | 2,500 | \$7,500 | 1,900 | \$5,700 | ----- | ----- | 4,400 | \$13,200 |
| 1897..... | 1 | 3,510 | 10,530 | 5,015 | 15,045 | ----- | ----- | 8,525 | 25,575 |
| 1898..... | 1 | 3,200 | 8,360 | 4,330 | 14,722 | ----- | ----- | 7,530 | 23,082 |
| 1899..... | 1 | 2,200 | 9,900 | 2,319 | 8,696 | 200 | \$550 | 4,719 | 19,146 |
| 1900..... | 1 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 1901..... | 1 | 876 | 4,380 | 3,740 | 16,830 | 360 | 1,260 | 4,976 | 22,470 |
| 1902..... | 1 | 600 | 3,168 | 1,917 | 8,147 | 500 | 2,000 | 3,017 | 13,315 |
| 1904..... | 1 | 1,000 | 5,000 | 3,300 | 13,200 | 1,000 | 2,000 | 5,300 | 20,200 |
| 1905..... | 1 | 1,500 | 9,000 | 1,700 | 7,225 | 900 | 2,250 | 4,100 | 18,475 |
| 1906..... | 1 | 2,635 | 15,810 | 3,192 | 9,576 | 167 | 418 | 5,994 | 25,804 |
| 1907..... | 1 | 2,333 | 16,331 | 4,300 | 12,900 | 200 | 600 | 6,833 | 29,831 |
| 1908..... | 1 | 2,100 | 14,700 | 4,700 | 16,450 | 300 | 900 | 7,100 | 32,050 |
| 1910..... | 1 | 2,200 | 15,400 | 4,600 | 25,300 | 250 | 750 | 7,050 | 41,450 |
| 1911..... | 1 | 3,584 | 28,672 | 7,164 | 39,402 | 237 | 901 | 10,985 | 68,975 |
| 1912..... | 1 | 3,277 | 19,662 | 6,554 | 32,770 | 283 | 707 | 10,114 | 53,139 |
| 1913..... | 1 | 15 | 75 | 354 | 1,416 | 17 | 37 | 386 | 1,528 |
| 1914..... | 1 | 3,356 | 23,492 | 6,712 | 36,245 | 196 | 490 | 10,264 | 60,227 |
| 1915..... | 1 | 100 | 600 | 3,000 | 13,600 | 100 | 280 | 3,200 | 14,680 |
| 1916..... | 1 | 1,000 | 8,000 | 3,000 | 15,000 | 210 | 630 | 4,210 | 23,630 |
| 1917..... | 1 | 1,800 | 16,200 | 3,400 | 28,200 | 222 | 1,554 | 5,422 | 45,954 |
| 1918..... | 2 | 4,304 | 47,344 | 7,789 | 74,774 | 384 | 2,688 | 12,477 | 124,806 |
| 1919..... | 2 | 1,393 | 17,413 | 5,892 | 70,704 | 472 | 3,021 | 7,757 | 91,138 |

PACK OF CANNED SALMON ON YAQUINA BAY AND RIVER, OREG., IN SPECIFIED YEARS.^a

| Year. | Can- neries oper- ated. | Chinook. | | Silverside. | | Chum. | | Total. | |
|-----------|----------------------------------|----------|---------|-------------|---------|--------|---------|--------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1887..... | 2 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 1888..... | 3 | ----- | ----- | ----- | ----- | ----- | ----- | 5,088 | \$29,256 |
| 1889..... | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 5,000 | 27,500 |
| 1891..... | 1 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 1896..... | 1 | 1,714 | \$5,142 | 615 | \$1,845 | ----- | ----- | 2,329 | 6,987 |
| 1898..... | 1 | 170 | 442 | 1,530 | 5,202 | ----- | ----- | 1,700 | 5,644 |
| 1899..... | 2 | 316 | 1,422 | 3,234 | 12,127 | 1,300 | \$3,575 | 4,850 | 17,124 |
| 1900..... | 1 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 1901..... | 1 | 96 | 480 | 2,848 | 12,816 | 549 | 1,647 | 3,493 | 14,943 |
| 1903..... | 1 | ----- | ----- | 1,238 | 5,262 | 315 | 787 | 1,553 | 6,049 |
| 1904..... | 1 | 50 | 200 | 2,600 | 8,840 | 450 | 1,080 | 3,100 | 10,120 |
| 1905..... | 1 | 200 | 1,200 | 2,050 | 8,613 | 62 | 155 | 2,312 | 9,968 |
| 1906..... | 1 | 500 | 3,000 | 3,100 | 9,300 | 60 | 150 | 3,660 | 12,450 |
| 1907..... | 1 | 834 | 5,838 | 1,000 | 3,000 | 49 | 147 | 1,883 | 8,985 |
| 1908..... | 1 | ----- | ----- | 4,000 | 14,000 | ----- | ----- | 4,000 | 14,000 |
| 1909..... | 1 | ----- | ----- | 1,139 | 4,556 | 33 | 76 | 1,172 | 4,632 |
| 1910..... | 1 | ----- | ----- | 2,669 | 13,345 | ----- | ----- | 2,669 | 13,345 |
| 1911..... | 1 | ----- | ----- | 1,009 | 5,549 | 51 | 289 | 1,060 | 5,838 |

^a Cannery not operated from 1912 to 1916, both years inclusive. In 1917 it was consolidated with Waldport cannery owned by same party.

PACK OF CANNED SALMON ON ALSEA RIVER AND BAY, OREG., IN SPECIFIED YEARS.

| Year. | Can-neries oper-ated. | Chinook. | | Siverside. | | Chum. | | Total. | |
|-------|-----------------------|----------|---------|------------|----------|--------|---------|--------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1886 | 1 | | | | | | | | |
| 1887 | 2 | | | | | | | 11,180 | \$64,285 |
| 1888 | 3 | | | | | | | 9,620 | 55,315 |
| 1889 | | | | | | | | 10,000 | 55,000 |
| 1891 | 1 | | | | | | | | |
| 1892 | 1 | | | 3,600 | \$14,400 | | | 3,600 | 14,400 |
| 1893 | 1 | 1,260 | \$6,300 | 3,240 | 12,960 | | | 4,500 | 19,260 |
| 1894 | 1 | 440 | 2,200 | 4,160 | 16,640 | | | 4,600 | 18,840 |
| 1895 | 1 | 1,700 | 6,375 | 3,280 | 11,808 | | | 4,980 | 18,183 |
| 1896 | 1 | 3,500 | 10,500 | 3,400 | 10,200 | | | 6,900 | 20,700 |
| 1897 | 1 | 1,800 | 5,400 | 3,200 | 9,600 | | | 5,000 | 15,000 |
| 1898 | 1 | 4,296 | 11,170 | 2,170 | 7,378 | | | 6,466 | 18,548 |
| 1899 | 1 | 2,150 | 9,138 | 5,010 | 19,038 | | | 7,160 | 28,176 |
| 1900 | 1 | | | | | | | | |
| 1901 | 1 | 695 | 3,475 | 4,629 | 18,790 | 891 | \$3,118 | 6,215 | 25,383 |
| 1902 | 1 | 701 | 3,702 | 4,530 | 19,253 | 670 | 2,680 | 5,901 | 25,035 |
| 1903 | 1 | 1,031 | 5,516 | 4,242 | 18,029 | 44 | 88 | 5,317 | 23,033 |
| 1904 | 1 | 1,000 | 5,000 | 6,500 | 26,000 | 300 | 690 | 7,800 | 31,600 |
| 1905 | 1 | 2,500 | 15,000 | 1,800 | 7,650 | 700 | 1,750 | 5,000 | 24,400 |
| 1906 | 1 | 3,702 | 22,212 | 3,843 | 11,529 | | | 7,545 | 33,741 |
| 1907 | 1 | 800 | 5,600 | 5,100 | 15,300 | 350 | 1,050 | 6,250 | 21,950 |
| 1908 | 1 | 1,200 | 8,400 | 6,000 | 21,000 | 400 | 1,200 | 7,600 | 30,600 |
| 1909 | 1 | 1,119 | 6,714 | 5,486 | 24,027 | 80 | 184 | 6,685 | 30,925 |
| 1910 | 1 | 2,500 | 17,500 | 5,900 | 31,950 | 100 | 300 | 8,500 | 49,750 |
| 1911 | 2 | 4,161 | 38,288 | 9,329 | 51,309 | 688 | 2,014 | 14,178 | 87,211 |
| 1912 | 2 | 3,731 | 22,386 | 8,286 | 41,430 | 524 | 1,510 | 12,541 | 65,126 |
| 1913 | 2 | 1,607 | 8,035 | 4,304 | 17,216 | 160 | 352 | 6,071 | 25,603 |
| 1914 | 2 | 4,546 | 31,822 | 6,728 | 36,331 | 73 | 183 | 11,347 | 68,336 |
| 1915 | 2 | 1,668 | 10,763 | 6,966 | 32,044 | 178 | 498 | 8,812 | 43,305 |
| 1916 | 2 | 2,624 | 20,992 | 3,804 | 19,820 | 292 | 876 | 6,780 | 41,188 |
| 1917 | 2 | 2,727 | 24,543 | 6,021 | 52,908 | 418 | 2,926 | 9,766 | 80,437 |
| 1918 | 2 | 2,000 | 22,000 | 7,215 | 69,264 | 312 | 2,178 | 10,068 | 99,934 |
| 1919 | 2 | 2,512 | 31,400 | 2,607 | 31,200 | 535 | 3,718 | 5,654 | 66,318 |

a Includes 541 cases of bluebacks, valued at \$6,492.

PACK OF CANNED SALMON ON THE SIUSLAU RIVER, OREG., IN SPECIFIED YEARS.

| Year. | Can-neries oper-ated. | Chinook. | | Siverside. | | Chum. | | Total. | |
|-------|-----------------------|----------|---------|------------|----------|--------|--------|--------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1878 | 2 | | | | | | | 10,300 | \$55,620 |
| 1879 | 2 | | | | | | | | |
| 1880 | 1 | | | | | | | 1,500 | |
| 1888 | 3 | | | | | | | 11,960 | 68,770 |
| 1890 | 1 | | | | | | | 12,000 | 66,000 |
| 1891 | 2 | | | | | | | | |
| 1892 | 2 | | | 18,600 | \$72,000 | | | 18,600 | 72,000 |
| 1893 | 2 | 1,471 | \$7,355 | 11,830 | 47,320 | | | 13,301 | 54,675 |
| 1894 | 2 | 1,871 | 9,355 | 14,987 | 59,948 | | | 16,858 | 69,303 |
| 1895 | 2 | 1,637 | 6,139 | 10,465 | 35,274 | | | 12,102 | 41,413 |
| 1896 | 1 | 2,700 | 8,100 | 9,000 | 27,000 | | | 11,700 | 35,100 |
| 1897 | 1 | 1,100 | 3,300 | 3,900 | 11,700 | | | 5,000 | 15,000 |
| 1898 | 1 | 850 | 2,210 | 10,000 | 34,000 | | | 10,850 | 36,210 |
| 1899 | 1 | 1,162 | 4,648 | 7,323 | 26,363 | 115 | \$445 | 8,600 | 31,356 |
| 1900 | 2 | | | | | | | | |
| 1901 | 1 | 1,735 | 8,675 | 7,488 | 29,952 | | | 9,223 | 38,627 |
| 1902 | 1 | 1,288 | 6,800 | 4,320 | 18,260 | | | 5,608 | 25,060 |
| 1903 | 1 | 1,619 | 8,127 | 6,842 | 28,079 | | | 8,361 | 37,206 |
| 1904 | 1 | 500 | 2,500 | 6,500 | 26,000 | | | 7,000 | 28,500 |
| 1905 | 1 | | | | | | | | |
| 1906 | 2 | 4,500 | 27,000 | 15,000 | 45,000 | 1,500 | 3,750 | 21,000 | 75,750 |
| 1907 | 1 | | | 15,773 | 47,819 | | | 15,773 | 47,819 |
| 1908 | 1 | | | 8,000 | 20,100 | | | 8,000 | 30,100 |
| 1909 | 2 | 632 | 3,792 | 7,436 | 32,956 | | | 8,068 | 36,748 |
| 1910 | 2 | 856 | 5,992 | 12,800 | 70,400 | 8,592 | 25,506 | 22,158 | 101,898 |
| 1911 | 2 | 1,120 | 8,960 | 10,268 | 56,463 | 5,000 | 19,000 | 16,386 | 84,423 |
| 1912 | 2 | | | 6,108 | 30,540 | | | 6,108 | 30,540 |
| 1913 | 2 | | | 4,281 | 17,124 | | | 4,281 | 17,124 |
| 1914 | 1 | | | 9,268 | 50,036 | | | 9,268 | 50,036 |
| 1915 | 1 | | | 1,755 | 8,073 | | | 1,755 | 8,073 |
| 1916 | 1 | 875 | 7,000 | 3,021 | 15,105 | | | 3,896 | 22,105 |
| 1917 | 1 | | | 350 | 2,800 | | | 350 | 2,800 |
| 1918 | 1 | | | 3,000 | 28,800 | | | 3,000 | 28,800 |
| 1919 | 1 | | | 3,760 | 43,120 | | | 3,760 | 43,120 |

a The two canneries combined and operated one plant.

PACK OF CANNED SALMON ON THE UMPQUA RIVER, OREG., IN SPECIFIED YEARS.^a

| Year. | Can-neries oper-ated. | Chinook. | | Siverside. | | Chum. | | Total. | |
|-------|-----------------------|----------|----------|------------|-----------|--------|--------|---------|-----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1878 | 2 | | | | | | | 8, 100 | \$43, 740 |
| 1879 | 2 | | | | | | | | |
| 1884 | 2 | | | | | | | 3, 700 | |
| 1885 | 1 | | | | | | | 10, 500 | |
| 1886 | 1 | | | | | | | 18, 600 | |
| 1887 | 1 | | | | | | | 4, 000 | 22, 000 |
| 1888 | 1 | | | | | | | 9, 000 | 51, 750 |
| 1889 | 1 | | | | | | | 12, 000 | 66, 000 |
| 1891 | 1 | | | | | | | | |
| 1892 | 1 | | | 10, 000 | \$40, 600 | | | 10, 000 | 40, 000 |
| 1893 | 1 | 809 | \$4, 045 | 3, 204 | 12, 816 | | | 4, 013 | 16, 861 |
| 1894 | 1 | 235 | 1, 175 | 6, 875 | 27, 500 | | | 7, 110 | 28, 675 |
| 1895 | 1 | 992 | 3, 720 | 7, 697 | 28, 863 | | | 8, 689 | 32, 583 |
| 1896 | 1 | 1, 300 | 3, 900 | 8, 000 | 24, 000 | | | 9, 300 | 27, 900 |
| 1899 | 2 | 925 | 3, 860 | 7, 576 | 27, 006 | 115 | \$345 | 8, 616 | 31, 211 |
| 1900 | 2 | | | | | | | | |
| 1903 | 1 | 23 | 123 | 6, 733 | 28, 615 | | | 6, 756 | 28, 738 |
| 1904 | 1 | 500 | 2, 500 | 9, 500 | 38, 000 | 500 | 1, 000 | 10, 500 | 41, 500 |
| 1905 | 1 | 6, 100 | 36, 600 | 10, 500 | 44, 625 | | | 16, 600 | 81, 225 |
| 1906 | 1 | 1, 143 | 6, 858 | 5, 613 | 16, 839 | | | 6, 756 | 23, 697 |
| 1909 | 1 | 500 | 3, 000 | 7, 753 | 31, 012 | | | 8, 253 | 34, 012 |
| 1910 | 1 | 2, 000 | 14, 000 | 11, 000 | 60, 500 | | | 13, 000 | 74, 500 |
| 1911 | 1 | 300 | 2, 400 | 6, 118 | 33, 649 | | | 6, 418 | 36, 049 |
| 1912 | 1 | 30 | 210 | 3, 759 | 18, 795 | | | 3, 789 | 19, 005 |
| 1914 | 1 | 1, 000 | 8, 000 | 2, 000 | 10, 000 | | | 3, 000 | 18, 000 |
| 1915 | 2 | | | 5, 100 | 23, 460 | | | 5, 100 | 23, 460 |
| 1916 | 2 | | | 2, 900 | 14, 500 | | | 2, 900 | 14, 500 |
| 1917 | 1 | | | 5, 366 | 42, 928 | 47 | 329 | 5, 413 | 43, 257 |
| 1918 | 1 | 1, 703 | 18, 733 | 3, 409 | 32, 726 | 1 | 7 | 5, 113 | 51, 466 |
| 1919 | 1 | | | 7, 500 | 90, 000 | | | 7, 500 | 90, 000 |

^a No canning done in 1913.

PACK OF CANNED SALMON ON COOS BAY AND RIVER, OREG., IN SPECIFIED YEARS.

| Year. | Can-neries oper-ated. | Chinook. | | Siverside. | | Total. | |
|-------|-----------------------|----------|---------|------------|-----------|---------|-----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1887 | 2 | | | | | 11, 300 | \$62, 150 |
| 1888 | 1 | | | | | 5, 500 | 31, 625 |
| 1889 | 1 | | | | | 7, 000 | \$8, 500 |
| 1891 | 2 | 3 | | | | | |
| 1893 | 1 | | | | | | |
| 1894 | 1 | 163 | \$815 | 3, 125 | \$12, 500 | 3, 125 | 12, 500 |
| 1895 | 1 | 5, 110 | 19, 163 | 8, 428 | 33, 712 | 8, 591 | 34, 527 |
| 1896 | 1 | 13, 000 | 39, 000 | 2, 332 | 8, 934 | 7, 442 | 28, 097 |
| 1897 | 1 | 6, 200 | 18, 600 | 2, 000 | 6, 000 | 15, 000 | 45, 000 |
| 1898 | 2 | 3, 142 | 8, 169 | 2, 200 | 6, 600 | 8, 400 | 25, 200 |
| 1898 | 2 | 1, 273 | 5, 092 | 7, 180 | 24, 412 | 10, 322 | 32, 581 |
| 1900 | 2 | | | 5, 174 | 18, 626 | 6, 447 | 23, 718 |
| 1901 | 1 | 1, 215 | 6, 075 | | | | |
| 1902 | 1 | 412 | 2, 175 | 4, 082 | 16, 328 | 5, 297 | 22, 403 |
| 1904 | 1 | 2, 033 | 7, 725 | 2, 640 | 11, 220 | 3, 052 | 13, 395 |
| 1906 | 1 | 2, 043 | 12, 258 | 7, 200 | 24, 480 | 9, 233 | 32, 205 |
| 1909 | 1 | 275 | 1, 475 | 1, 755 | 5, 265 | 3, 798 | 17, 523 |
| 1910 | 1 | 500 | 3, 500 | 3, 959 | 17, 927 | 4, 234 | 19, 402 |
| 1911 | 2 | 2, 630 | 21, 040 | 5, 500 | 30, 250 | 6, 000 | 33, 750 |
| 1912 | 2 | 1, 457 | 10, 199 | 7, 260 | 39, 930 | 9, 890 | 60, 970 |
| 1913 | 2 | | | 3, 989 | 19, 945 | 5, 446 | 20, 144 |
| 1914 | 1 | | | 7, 383 | 29, 532 | 7, 383 | 29, 532 |
| 1915 | 1 | | | 9, 300 | 50, 220 | 9, 300 | 50, 220 |
| 1916 | 1 | | | 3, 500 | 16, 100 | 3, 500 | 16, 100 |
| 1917 | 1 | | | 2, 485 | 12, 425 | 2, 485 | 12, 425 |
| 1918 | 1 | | | | | | |
| 1918 | 1 | | | 3, 800 | 36, 480 | 3, 800 | 36, 480 |

PACK OF CANNED SALMON ON COQUILLE RIVER, OREG., IN SPECIFIED YEARS.

| Year. | Canneries operated. | Chinook. | | Silverside. | | Total. | |
|-------|---------------------|----------|---------|-------------|----------|----------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1883. | 1 | | | | | 7,000 | |
| 1884. | 1 | | | | | 7,300 | |
| 1885. | 1 | | | | | 3,800 | |
| 1886. | 2 | | | | | 8,300 | |
| 1887. | 3 | | | | | | |
| 1888. | 2 | | | | | 11,000 | \$63,250 |
| 1889. | | | | | | 8,600 | 47,300 |
| 1891. | 1 | | | | | | |
| 1892. | 1 | | | 5,000 | \$20,000 | 5,000 | 20,000 |
| 1893. | 1 | | | 6,500 | 26,000 | 6,500 | 26,000 |
| 1894. | a 1 | | | 2,000 | 8,000 | 2,000 | 8,000 |
| 1895. | 2 | 760 | \$2,887 | 8,724 | 32,615 | 9,484 | 35,502 |
| 1896. | 2 | 1,225 | 3,675 | 7,800 | 23,400 | 9,025 | 27,075 |
| 1898. | 2 | 541 | 1,407 | 7,485 | 25,499 | 8,026 | 26,906 |
| 1899. | 2 | 950 | 3,800 | 7,550 | 28,500 | 8,500 | 32,300 |
| 1900. | 1 | 2,636 | 13,180 | 9,601 | 38,404 | 12,237 | 51,584 |
| 1901. | 1 | 133 | 665 | 5,096 | 20,384 | 5,229 | 21,049 |
| 1902. | 1 | 286 | 1,510 | 5,877 | 24,927 | 6,163 | 26,437 |
| 1903. | 1 | 331 | 1,771 | 8,685 | 36,911 | 9,016 | 38,682 |
| 1904. | 2 | 600 | 2,400 | 13,686 | 54,744 | 14,286 | 57,144 |
| 1905. | 2 | 2,100 | 12,600 | 11,343 | 48,208 | 13,443 | 60,808 |
| 1906. | 2 | 821 | 4,926 | 17,979 | 53,937 | 18,800 | 58,863 |
| 1907. | 2 | 306 | 2,142 | 13,220 | 39,660 | 13,526 | 41,802 |
| 1908. | | | | 19,174 | 67,109 | 19,174 | 67,109 |
| 1909. | 2 | 250 | 1,255 | 9,818 | 42,687 | 10,068 | 43,942 |
| 1910. | 2 | 420 | 2,940 | 16,637 | 91,504 | 17,057 | 94,444 |
| 1911. | 2 | 715 | 5,720 | 16,676 | 91,718 | 17,391 | 97,438 |
| 1912. | 2 | 377 | 2,639 | 6,040 | 30,200 | 6,417 | 32,839 |
| 1913. | 2 | | | 8,910 | 35,640 | 8,910 | 35,640 |
| 1914. | 2 | | | 12,097 | 65,324 | 12,097 | 65,324 |
| 1915. | 2 | 1,079 | 6,474 | 5,131 | 25,515 | 6,210 | 31,989 |
| 1916. | 2 | 869 | 6,952 | 2,652 | 13,260 | 3,521 | 20,212 |
| 1917. | 2 | 694 | 6,216 | 8,005 | 64,040 | b 8,706 | 70,335 |
| 1918. | 2 | 1,318 | 14,498 | 10,096 | 96,922 | c 11,650 | 113,129 |
| 1919. | 2 | 1,027 | 12,837 | 5,010 | 60,120 | d 6,082 | 72,957 |

a Burned.

b Includes 7 cases of chums, valued at \$49.

c Includes 217 cases of chums, valued at \$1,519, and 19 cases of steelheads, valued at \$100.

d Includes 45 cases of chums.

PACK OF CANNED SALMON ON ROGUE RIVER, OREG., IN SPECIFIED YEARS.^a

| Year. | Canneries operated. | Chinook. | | Silverside. | | Total. | |
|-------|---------------------|----------|----------|-------------|----------|--------|-----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1877. | 1 | | | | | 7,804 | |
| 1878. | 1 | | | | | 8,534 | |
| 1879. | 1 | | | | | 8,571 | |
| 1880. | 1 | | | | | 7,772 | |
| 1881. | 1 | | | | | 12,320 | |
| 1882. | 1 | | | | | 19,186 | |
| 1883. | 1 | | | | | 16,156 | |
| 1884. | 1 | | | | | 12,376 | |
| 1885. | 1 | | | | | 9,310 | |
| 1886. | 1 | | | | | 12,147 | |
| 1887. | 1 | | | | | 17,216 | |
| 1888. | 1 | | | | | 21,062 | \$121,107 |
| 1889. | 1 | | | | | 22,000 | 132,000 |
| 1890. | 1 | | | | | 21,000 | 120,000 |
| 1891. | 1 | | | | | 21,000 | 105,000 |
| 1892. | 1 | 10,000 | \$50,000 | 9,000 | \$45,000 | 19,000 | 95,000 |
| 1893. | b 1 | 3,200 | 16,000 | | | 3,200 | 16,000 |
| 1894. | 1 | 10,377 | 41,508 | 1,285 | 15,347 | 11,662 | 56,855 |
| 1895. | 1 | 15,000 | 75,000 | 3,000 | 9,000 | 18,000 | 84,000 |
| 1896. | 1 | 15,355 | 61,429 | 3,653 | 10,959 | 19,008 | 72,379 |
| 1897. | 1 | 12,954 | 51,559 | 301 | 1,303 | 13,255 | 52,862 |
| 1898. | 1 | 5,481 | 30,145 | 1,745 | 6,980 | 7,226 | 37,125 |
| 1899. | 1 | | | | | | |

a Shut down in 1911 and 1912 through the closing of the river to all fishing.

b Burned down during season. Not opened the next year.

PACK OF CANNED SALMON ON ROGUE RIVER, OREG., IN SPECIFIED YEARS—Contd.

| Year. | Canneries operated. | Chinook. | | Siverside. | | Total. | |
|-----------|---------------------|----------|----------|------------|----------|--------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1901..... | 1 | 2,681 | \$13,405 | 4,184 | \$17,736 | 6,865 | \$31,141 |
| 1902..... | 1 | 3,799 | 20,058 | 4,091 | 17,387 | 7,890 | 37,445 |
| 1903..... | 1 | 8,418 | 45,036 | 4,792 | 20,366 | 13,210 | 65,402 |
| 1904..... | 1 | 16,000 | 84,000 | 3,255 | 11,392 | 19,255 | 75,392 |
| 1905..... | 1 | 18,500 | 111,000 | 1,500 | 6,375 | 20,000 | 117,375 |
| 1906..... | 1 | 12,000 | 72,000 | 6,000 | 18,000 | 18,000 | 90,000 |
| 1907..... | 1 | 7,537 | 56,528 | 1,796 | 8,980 | 9,333 | 65,508 |
| 1908..... | 1 | 4,364 | 32,855 | 2,650 | 13,250 | 7,004 | 45,905 |
| 1909..... | 1 | 186 | 1,300 | 699 | 2,977 | 885 | 4,277 |
| 1910..... | 1 | 232 | 1,786 | 2,711 | 16,266 | 2,943 | 18,052 |
| 1913..... | 1 | 3,020 | 27,160 | 2,403 | 11,857 | 5,423 | 39,017 |
| 1914..... | 1 | 6,938 | 62,060 | 987 | 5,453 | 7,925 | 67,513 |
| 1915..... | 2 | 19,094 | 135,301 | 515 | 2,369 | 19,609 | 137,670 |
| 1916..... | 2 | 22,640 | 181,120 | 501 | 2,505 | 23,141 | 183,625 |
| 1917..... | 2 | 24,707 | 271,777 | 660 | 5,280 | 25,367 | 277,057 |
| 1918..... | 2 | 20,469 | 225,159 | 2,704 | 24,336 | 23,173 | 249,495 |
| 1919..... | 3 | 17,237 | 215,463 | 671 | 8,052 | 17,908 | 223,515 |

PACK OF CANNED SALMON ON SMITH RIVER, CALIF., IN SPECIFIED YEARS.

| Year. | Canneries operated. | Quinnat. | | Siverside. | | Total. | |
|-----------|---------------------|----------|----------|------------|---------|--------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1878..... | 1 | 4,277 | \$23,096 | ..... | ..... | 4,277 | \$23,096 |
| 1880..... | 1 | 7,500 | 41,250 | ..... | ..... | 7,500 | 41,250 |
| 1884..... | 1 | 5,500 | 33,000 | ..... | ..... | 5,500 | 33,000 |
| 1885..... | 1 | 1,550 | 9,300 | ..... | ..... | 1,550 | 9,300 |
| 1888..... | 1 | 2,347 | 14,082 | ..... | ..... | 2,347 | 14,082 |
| 1893..... | 1 | 1,500 | 7,500 | 500 | \$1,500 | 2,000 | 9,000 |
| 1894..... | 1 | 1,500 | 7,500 | 500 | 1,500 | 2,000 | 9,000 |
| 1895..... | 1 | 2,250 | 9,990 | ..... | ..... | 2,250 | 9,990 |
| 1914..... | 1 | ..... | ..... | 3,000 | 18,000 | 3,000 | 18,000 |
| 1915..... | 1 | 1,955 | 13,685 | 1,078 | 6,220 | 3,033 | 19,905 |
| 1916..... | 1 | 1,515 | 12,120 | 990 | 4,950 | 2,505 | 17,070 |
| 1917..... | 1 | 6,300 | 69,300 | ..... | ..... | 6,300 | 69,300 |
| 1918..... | 1 | 4,041 | 44,451 | 612 | 5,508 | 4,653 | 49,959 |
| 1919..... | 1 | 4,366 | 50,758 | ..... | ..... | 4,366 | 50,758 |

PACK OF CANNED SALMON ON KLAMATH RIVER, CALIF., IN SPECIFIED YEARS.

| Year. | Canneries operated. | Quinnat. | | Siverside. | | Total. | |
|-----------|---------------------|----------|----------|------------|---------|---------------------|----------|
| | | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1888..... | 1 | 4,400 | \$26,400 | ..... | ..... | 4,400 | \$26,400 |
| 1892..... | 1 | 1,047 | 4,188 | ..... | ..... | 1,047 | 4,188 |
| 1893..... | 1 | 1,600 | 6,400 | ..... | ..... | 1,600 | 6,400 |
| 1894..... | 1 | 1,700 | 6,800 | ..... | ..... | 1,700 | 6,800 |
| 1895..... | 1 | 1,200 | 5,321 | 400 | \$1,500 | 1,600 | 6,821 |
| 1899..... | 1 | 1,600 | 8,800 | ..... | ..... | 1,600 | 8,800 |
| 1902..... | 1 | 2,500 | 13,500 | ..... | ..... | 2,500 | 13,500 |
| 1904..... | 1 | 3,400 | 20,800 | ..... | ..... | 3,400 | 20,800 |
| 1909..... | 1 | 5,633 | 33,000 | ..... | ..... | 5,633 | 33,000 |
| 1910..... | 1 | 8,016 | 52,000 | ..... | ..... | 8,016 | 52,000 |
| 1911..... | 1 | 7,400 | 46,000 | 204 | 816 | 7,604 | 46,816 |
| 1912..... | 2 | 18,000 | 117,000 | ..... | ..... | 18,000 | 117,000 |
| 1913..... | 2 | 6,376 | 40,500 | ..... | ..... | 6,376 | 40,500 |
| 1914..... | 1 | 7,500 | 48,500 | 3,500 | 14,000 | 11,000 | 62,500 |
| 1915..... | 1 | 10,400 | 72,800 | 2,500 | 13,000 | 12,900 | 85,800 |
| 1916..... | 1 | 6,484 | 51,872 | 2,400 | 12,000 | 8,884 | 63,872 |
| 1917..... | 1 | 5,130 | 56,430 | 2,900 | 23,200 | 8,030 | 79,630 |
| 1918..... | 1 | 5,555 | 61,105 | 4,292 | 38,628 | ^a 10,200 | 102,557 |
| 1919..... | 1 | 6,291 | 81,783 | 1,145 | 13,740 | ^b 7,731 | 95,523 |

^a Includes 353 cases of steelheads, valued at \$2,824.^b Includes 295 cases of steelheads.

PACK OF CANNED SALMON ON EEL RIVER, CALIF., IN SPECIFIED YEARS.^a

| Year. | Canneries operated. | Quinnat. | | Year. | Canneries operated. | Quinnat. | |
|-----------|---------------------|----------|----------|-----------|---------------------|----------|----------|
| | | Cases. | Value. | | | Cases. | Value. |
| 1877..... | 1 | 8,500 | \$51,000 | 1885..... | 1 | 5,750 | ..... |
| 1878..... | 1 | 10,500 | 56,700 | 1886..... | 1 | 12,500 | \$75,000 |
| 1880..... | 1 | 6,250 | ..... | 1910..... | 1 | 6,000 | 42,000 |
| 1883..... | 1 | 16,000 | ..... | 1911..... | 1 | 8,400 | 52,500 |
| 1884..... | 1 | 8,200 | ..... | 1912..... | 1 | 11,000 | 71,500 |

^a Shut down since 1912.

PACK OF CANNED SALMON ON NOYO RIVER, CALIF., IN SPECIFIED YEARS.

| Year. | Can- neries operated. | Quinnat. | |
|-----------|-----------------------------|----------|----------|
| | | Cases. | Value. |
| 1918..... | 1 | 2,000 | \$22,000 |
| 1919..... | 1 | 7,500 | 97,500 |

PACK OF CANNED SALMON ON THE SACRAMENTO RIVER IN SPECIFIED YEARS.

| Year. | Canneries operated. | Quinnat. | | Year. | Canneries operated. | Quinnat. | |
|-----------|---------------------|----------|-----------|-----------|---------------------|----------|-----------|
| | | Cases. | Value. | | | Cases. | Value. |
| 1864..... | 1 | 2,000 | ..... | 1893..... | 3 | 23,336 | ..... |
| 1865..... | 1 | 2,000 | ..... | 1894..... | 2 | 28,463 | ..... |
| 1874..... | ..... | 2,500 | ..... | 1895..... | 3 | 25,185 | \$111,821 |
| 1875..... | ..... | 3,000 | ..... | 1896..... | ..... | 13,367 | ..... |
| 1876..... | 2 | 10,000 | ..... | 1897..... | ..... | 38,543 | ..... |
| 1877..... | ..... | 21,500 | ..... | 1898..... | ..... | 29,731 | ..... |
| 1878..... | 6 | 34,017 | \$183,692 | 1899..... | ..... | 32,580 | 150,688 |
| 1879..... | 4 | 13,555 | 59,577 | 1900..... | ..... | 39,304 | ..... |
| 1880..... | 9 | 62,000 | ..... | 1901..... | ..... | 17,500 | ..... |
| 1881..... | 20 | 181,200 | ..... | 1902..... | ..... | 14,043 | ..... |
| 1882..... | 19 | 200,000 | ..... | 1903..... | ..... | 8,200 | ..... |
| 1883..... | 21 | 123,000 | ..... | 1904..... | 2 | 14,407 | 66,936 |
| 1884..... | ..... | 81,450 | ..... | 1905..... | 1 | 2,760 | ..... |
| 1885..... | 6 | 90,000 | ..... | 1911..... | 1 | 4,142 | 28,994 |
| 1886..... | 9 | 39,300 | ..... | 1913..... | 1 | 950 | 6,650 |
| 1887..... | ..... | 36,500 | ..... | 1914..... | 2 | 17,315 | 95,232 |
| 1888..... | 6 | 68,075 | 423,750 | 1915..... | 2 | 5,229 | 35,453 |
| 1889..... | 3 | 57,300 | ..... | 1916..... | 1 | 6,636 | 53,088 |
| 1890..... | ..... | 25,065 | ..... | 1917..... | 3 | 9,443 | 94,430 |
| 1891..... | ..... | 10,353 | ..... | 1918..... | 2 | 4,036 | 44,396 |
| 1892..... | ..... | 2,281 | ..... | 1919..... | 2 | 1,169 | 15,197 |

PACK OF CANNED SALMON AT MONTEREY BAY IN SPECIFIED YEARS.

| Year. | Canneries operated. | Quinnat. | | Year. | Canneries operated. | Quinnat. | |
|-----------|---------------------|----------|---------|-----------|---------------------|----------|----------|
| | | Cases. | Value. | | | Cases. | Value. |
| 1915..... | 1 | 950 | \$7,300 | 1918..... | ..... | ..... | ..... |
| 1916..... | 1 | 12,809 | 102,472 | 1919..... | 1 | 2,000 | \$26,000 |
| 1917..... | 1 | 2,000 | 20,000 | | | | |

PACK OF CANNED SALMON IN ALASKA, BY DISTRICTS, SINCE THE INCEPTION OF THE INDUSTRY.

| Year. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|------------|---------------------|---------------|---------------------|---------------|---------------------|---------------|---------------------|---------------|
| | Canneries operated. | Pack. | Canneries operated. | Pack. | Canneries operated. | Pack. | Canneries operated. | Pack. |
| | | <i>Cases.</i> | | <i>Cases.</i> | | <i>Cases.</i> | | <i>Cases.</i> |
| 1878..... | 2 | 8,159 | | | | | 2 | 8,159 |
| 1879..... | 2 | 12,530 | | | | | 2 | 12,530 |
| 1880..... | 1 | 6,539 | | | | | 1 | 6,539 |
| 1881..... | 1 | 8,977 | | | | | 1 | 8,977 |
| 1882..... | 1 | 11,501 | 2 | 10,244 | | | 3 | 21,745 |
| 1883..... | 4 | 20,040 | 2 | 28,297 | | | 6 | 48,337 |
| 1884..... | 4 | 22,189 | 2 | 42,297 | 1 | a 400 | 7 | 64,886 |
| 1885..... | 3 | 16,728 | 2 | 52,687 | 1 | 14,000 | 6 | 83,415 |
| 1886..... | 4 | 18,660 | 2 | 74,583 | 3 | 48,822 | 9 | 142,065 |
| 1887..... | 5 | 31,462 | 2 | 102,515 | 3 | 72,700 | 10 | 206,677 |
| 1888..... | 6 | 81,128 | 6 | 241,101 | 4 | 89,886 | 16 | 412,115 |
| 1889..... | 12 | 141,760 | 21 | 461,451 | 4 | 115,985 | 37 | 719,196 |
| 1890..... | 12 | 142,901 | 19 | 421,300 | 4 | 118,390 | 35 | 682,591 |
| 1891..... | 11 | 156,615 | 14 | 511,367 | 5 | 133,418 | 30 | 801,400 |
| 1892..... | 7 | 115,722 | 6 | 295,496 | 2 | 63,499 | 15 | 474,717 |
| 1893..... | 8 | 135,053 | 11 | 399,815 | 3 | 107,786 | 22 | 643,654 |
| 1894..... | 7 | 142,544 | 10 | 435,052 | 4 | 108,844 | 21 | 686,440 |
| 1895..... | 7 | 148,476 | 10 | 327,919 | 6 | 150,135 | 23 | 626,530 |
| 1896..... | 9 | 262,381 | 12 | 485,990 | 8 | 218,336 | 29 | 966,707 |
| 1897..... | 9 | 271,867 | 13 | 382,899 | 7 | 254,312 | 29 | 909,078 |
| 1898..... | 9 | 251,385 | 14 | 395,009 | 7 | 318,703 | 30 | 965,097 |
| 1899..... | 9 | 310,219 | 14 | 356,095 | 9 | 411,832 | 32 | 1,078,146 |
| 1900..... | 16 | 456,639 | 14 | 492,223 | 12 | 599,277 | 42 | 1,548,139 |
| 1901..... | 21 | 735,449 | 13 | 562,142 | 21 | 719,213 | 55 | 2,016,804 |
| 1902..... | 26 | 906,676 | 12 | 583,690 | 26 | 1,046,458 | 64 | 2,536,824 |
| 1903..... | 21 | 642,305 | 12 | 417,175 | 27 | 1,186,730 | 60 | 2,246,210 |
| 1904..... | 12 | 569,003 | 11 | 499,485 | 32 | 885,268 | 55 | 1,953,756 |
| 1905..... | 13 | 433,607 | 9 | 371,755 | 25 | 1,089,154 | 47 | 1,894,516 |
| 1906..... | 20 | 767,285 | 8 | 473,024 | 19 | 978,735 | 47 | 2,219,044 |
| 1907..... | 22 | 887,503 | 8 | 522,836 | 18 | 759,534 | 48 | 2,169,873 |
| 1908..... | 23 | 1,022,723 | 8 | 425,721 | 19 | 1,169,604 | 50 | 2,618,048 |
| 1909..... | 19 | 852,870 | 8 | 391,054 | 18 | 1,151,553 | 45 | 2,395,477 |
| 1910..... | 23 | 1,066,399 | 10 | 432,517 | 19 | 914,138 | 52 | 2,413,054 |
| 1911..... | 32 | 1,580,868 | 11 | 499,743 | 21 | 743,206 | 64 | 2,823,817 |
| 1912..... | 51 | 2,033,648 | 14 | 625,062 | 22 | 1,395,931 | 87 | 4,054,641 |
| 1913..... | 42 | 1,782,898 | 14 | 447,249 | 23 | 1,509,038 | 79 | 3,739,185 |
| 1914..... | 44 | 1,776,076 | 14 | 658,791 | 23 | 1,621,787 | 81 | 4,056,653 |
| 1915..... | 46 | 2,549,212 | 17 | 632,848 | 24 | 1,318,233 | 87 | 4,500,293 |
| 1916..... | 54 | 2,214,280 | 19 | 1,075,913 | 27 | 1,610,434 | 100 | 4,900,627 |
| 1917..... | 62 | 3,294,845 | 27 | 1,017,206 | 29 | 1,635,235 | 118 | 5,947,286 |
| 1918..... | 76 | 3,375,445 | 29 | 1,391,951 | 30 | 1,838,439 | 135 | 6,605,835 |
| 1919..... | 75 | 3,108,364 | 30 | 775,557 | 28 | 708,280 | 133 | 4,592,201 |
| Total..... | | 32,373,930 | | 17,320,059 | | 25,107,295 | | 74,801,284 |

a Experimental pack.

PACK OF CANNED SALMON IN ALASKA FROM 1898 TO 1919, BY SPECIES.

| Year. | Coho, or silver. | | Chum, or keta. | | Humpback, or pink. | |
|-----------|------------------|-----------|----------------|-----------|--------------------|------------|
| | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1898..... | 54,711 | ..... | 5,184 | ..... | 109,399 | ..... |
| 1899..... | 39,402 | ..... | 1,931 | ..... | 149,159 | ..... |
| 1900..... | 50,984 | ..... | 30,012 | ..... | 232,022 | ..... |
| 1901..... | 65,500 | ..... | 47,464 | ..... | 541,427 | ..... |
| 1902..... | 82,723 | ..... | 159,849 | ..... | 549,602 | ..... |
| 1903..... | 120,506 | ..... | 35,052 | ..... | 355,799 | ..... |
| 1904..... | 85,741 | ..... | 21,178 | ..... | 299,333 | ..... |
| 1905..... | 67,394 | \$215,875 | 41,972 | \$113,056 | 168,597 | \$498,194 |
| 1906..... | 109,141 | 382,109 | 254,812 | 730,235 | 348,297 | 1,046,951 |
| 1907..... | 85,190 | 337,384 | 184,173 | 547,757 | 501,973 | 1,799,280 |
| 1908..... | 68,932 | 274,089 | 218,513 | 554,197 | 644,133 | 1,733,379 |
| 1909..... | 56,556 | 231,029 | 120,712 | 274,110 | 464,873 | 1,114,839 |
| 1910..... | 114,026 | 559,666 | 254,218 | 773,409 | 554,322 | 1,764,055 |
| 1911..... | 133,908 | 702,647 | 323,795 | 1,199,563 | 1,005,278 | 3,972,706 |
| 1912..... | 166,198 | 741,377 | 664,033 | 1,584,130 | 1,280,138 | 3,296,598 |
| 1913..... | 75,779 | 261,654 | 200,918 | 643,948 | 1,372,881 | 3,550,557 |
| 1914..... | 157,063 | 690,086 | 663,859 | 2,240,765 | 986,049 | 3,459,116 |
| 1915..... | 124,268 | 536,124 | 479,946 | 1,243,321 | 1,875,516 | 5,217,203 |
| 1916..... | 261,909 | 1,399,491 | 724,115 | 2,420,600 | 1,737,793 | 6,330,185 |
| 1917..... | 193,231 | 1,682,745 | 906,747 | 5,572,047 | 2,296,976 | 14,794,062 |
| 1918..... | 218,958 | 2,004,979 | 1,364,960 | 8,562,878 | 2,438,954 | 16,065,456 |
| 1919..... | 230,138 | 2,761,656 | 1,348,462 | 8,630,157 | 1,657,434 | 13,259,472 |

| Year. | King, or spring. | | Red, or sockeye. | | Total. | |
|-----------|------------------|-----------|------------------|-------------|-----------|-------------|
| | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| 1898..... | 12,862 | ..... | 782,941 | ..... | 965,097 | ..... |
| 1899..... | 23,400 | ..... | 804,254 | ..... | 1,078,146 | ..... |
| 1900..... | 37,715 | ..... | 1,107,406 | ..... | 1,548,139 | ..... |
| 1901..... | 45,000 | ..... | 1,314,335 | ..... | 2,046,804 | ..... |
| 1902..... | 59,104 | ..... | 1,685,506 | ..... | 2,536,824 | ..... |
| 1903..... | 47,000 | ..... | 1,687,204 | ..... | 2,246,210 | ..... |
| 1904..... | 41,956 | ..... | 1,505,548 | ..... | 1,953,756 | ..... |
| 1905..... | 42,125 | \$141,999 | 1,574,428 | \$5,335,547 | 1,894,516 | \$6,304,671 |
| 1906..... | 30,834 | 116,222 | 1,475,960 | 5,620,875 | 2,219,044 | 7,896,392 |
| 1907..... | 43,424 | 181,718 | 1,295,113 | 5,915,227 | 2,169,873 | 8,781,366 |
| 1908..... | 23,792 | 99,867 | 1,662,678 | 7,524,251 | 2,618,048 | 10,185,783 |
| 1909..... | 48,034 | 207,624 | 1,705,302 | 7,610,550 | 2,395,477 | 9,438,152 |
| 1910..... | 40,221 | 214,802 | 1,450,267 | 7,774,390 | 2,413,054 | 11,086,322 |
| 1911..... | 45,518 | 295,088 | 1,315,318 | 8,363,233 | 2,823,817 | 14,593,237 |
| 1912..... | 43,317 | 243,331 | 1,900,355 | 10,426,481 | 4,054,641 | 16,291,917 |
| 1913..... | 34,370 | 130,053 | 1,965,237 | 8,936,362 | 3,739,185 | 13,531,604 |
| 1914..... | 48,039 | 241,105 | 2,201,643 | 12,289,517 | 4,056,653 | 18,920,589 |
| 1915..... | 88,251 | 408,266 | 1,932,312 | 11,248,101 | 4,500,293 | 18,653,015 |
| 1916..... | 65,873 | 353,420 | 2,110,937 | 12,765,733 | 4,900,627 | 23,269,429 |
| 1917..... | 61,951 | 644,447 | 2,488,381 | 23,610,789 | 5,947,286 | 46,304,090 |
| 1918..... | 40,226 | 485,295 | 2,533,737 | 23,920,347 | 6,605,835 | 51,041,949 |
| 1919..... | 151,733 | 1,820,796 | 1,204,343 | 15,656,469 | 4,592,201 | 42,128,540 |

a Includes 91 cases of steelheads; value not given.

OUTPUT ^a OF CANNED SALMON IN ALASKA, 1912 TO 1918.^b

| Product. | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | Total. |
|------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Coho, or silver: | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> |
| ½-pound flat..... | 2,719 | 3,587 | 4,579 | 2,050 | 13,145 | 30,412 | 26,238 | 82,720 |
| 1-pound flat..... | 17 | 266 | 285 | 2,338 | 8,191 | 362 | 12,786 | 24,245 |
| 1-pound tall..... | 163,462 | 71,926 | 152,199 | 119,880 | 240,573 | 162,457 | 179,934 | 1,090,431 |
| Total..... | 166,198 | 75,779 | 167,063 | 124,268 | 261,909 | 193,231 | 218,958 | 1,197,406 |
| Chum, or keta: | | | | | | | | |
| ½-pound flat..... | 2,795 | 985 | 373 | ..... | 1,423 | 26,760 | 3,559 | 35,895 |
| 1-pound flat..... | ..... | 2,619 | 5,565 | 317 | ..... | 2,530 | 2,996 | 14,030 |
| 1-pound tall..... | 661,838 | 237,314 | 657,918 | 479,629 | 722,632 | 877,457 | 1,358,405 | 5,045,263 |
| Total..... | 664,633 | 290,918 | 663,859 | 479,946 | 724,115 | 906,747 | 1,364,960 | 5,065,178 |
| Humpback, or pink: | | | | | | | | |
| ½-pound flat..... | 13,712 | 20,822 | 2,103 | 4,325 | 41,491 | 91,403 | 63,557 | 237,413 |
| 1-pound flat..... | ..... | 3,258 | 9,286 | 3,508 | 14,786 | 6,014 | 20,215 | 57,077 |
| 1-pound tall..... | 1,266,426 | 1,348,801 | 974,660 | 1,867,683 | 1,681,506 | 2,199,559 | 2,355,182 | 11,093,817 |
| Total..... | 1,280,138 | 1,372,881 | 986,049 | 1,875,516 | 1,737,793 | 2,296,976 | 2,438,954 | 11,988,307 |
| King, or spring: | | | | | | | | |
| ½-pound flat..... | 5,151 | 1,585 | 3,143 | 2,404 | 2,617 | 12,973 | 6,000 | 33,873 |
| 1-pound flat..... | ..... | ..... | 4,804 | 3,755 | 3,804 | 5,133 | 5,267 | 22,763 |
| 1-pound tall..... | 38,166 | 32,785 | 40,092 | 82,092 | 59,452 | 43,845 | 37,959 | 334,391 |
| Total..... | 43,317 | 34,370 | 48,039 | 88,251 | 65,873 | 61,951 | 49,226 | 391,027 |
| Red, or sockeye: | | | | | | | | |
| ½-pound flat..... | 28,024 | 29,041 | 53,825 | 52,033 | 81,565 | 124,309 | 137,008 | 505,805 |
| 1-pound flat..... | 16,242 | 11,735 | 64,671 | 112,847 | 86,395 | 89,612 | 161,864 | 533,366 |
| 1-pound tall..... | 1,856,089 | 1,924,461 | 2,083,147 | 1,765,139 | 1,936,971 | 2,274,460 | 2,244,865 | 14,085,132 |
| 1½-pound nominals..... | ..... | ..... | ..... | 2,293 | ..... | ..... | ..... | 2,293 |
| 2-pound nominals..... | ..... | ..... | ..... | ..... | 6,006 | ..... | ..... | 6,006 |
| Total..... | 1,900,355 | 1,965,237 | 2,201,643 | 1,932,312 | 2,110,937 | 2,488,381 | 2,533,737 | 15,132,602 |
| Grand total.... | 4,054,641 | 3,739,185 | 4,056,653 | 4,500,293 | 4,900,627 | 5,947,286 | 6,605,835 | 33,804,520 |

AVERAGE ANNUAL PRICE PER CASE OF FORTY-EIGHT 1-POUND CANS OF ALASKA SALMON, 1908 TO 1918.^b

| Product. | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 |
|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Coho, or silver..... | \$3.98 | \$4.07 | \$4.89 | \$5.67 | \$4.44 | \$3.45 | \$4.39 | \$4.31 | \$5.34 | \$8.76 | \$9.15 |
| Chum, or keta..... | 2.53 | 2.28 | 3.04 | 3.72 | 2.37 | 2.21 | 3.37 | 2.59 | 3.34 | 6.14 | 6.27 |
| Humpback, or pink..... | 2.69 | 2.40 | 3.15 | 3.94 | 2.55 | 2.58 | 3.50 | 2.78 | 3.04 | 6.44 | 6.58 |
| King, or spring..... | 4.20 | 4.32 | 5.34 | 6.48 | 5.37 | 4.04 | 5.01 | 4.63 | 5.36 | 10.40 | 9.85 |
| Red, or sockeye..... | 4.52 | 4.53 | 5.30 | 6.33 | 5.45 | 4.54 | 5.58 | 5.82 | 6.04 | 9.48 | 9.44 |

^a The number of cases shown has been put upon the common basis of forty-eight 1-pound cans per case.^b From "Alaska Fisheries and Fur Industries in 1918," p. 49, by Ward T. Bower. Appendix VII, Report, U. S. Commissioner of Fisheries, 1918. Washington, 1919.

PACK OF CANNED SALMON IN BRITISH COLUMBIA SINCE THE INCEPTION OF THE INDUSTRY, BY WATERS.

| Year. | Canneries operated. | Fraser River. | Skeena River. | Rivers Inlet. | Naas River. | Outlying districts. | Total. |
|------------|---------------------|---------------|---------------|---------------|---------------|---------------------|---------------|
| | | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> |
| 1876..... | 2 | 7,247 | | | | | 7,247 |
| 1877..... | 5 | 55,387 | 3,000 | | | | 58,387 |
| 1878..... | 8 | 81,446 | 8,500 | | | | 89,946 |
| 1879..... | 9 | 50,490 | 10,603 | | | | 61,093 |
| 1880..... | 9 | 42,155 | 19,694 | | | | 61,849 |
| 1881..... | 11 | 142,516 | 21,560 | | | 5,500 | 169,576 |
| 1882..... | 16 | 199,204 | 24,522 | 5,635 | 6,500 | 4,600 | 240,461 |
| 1883..... | 20 | 105,701 | 31,157 | 10,780 | 9,400 | 6,400 | 163,438 |
| 1884..... | 14 | 34,037 | 53,786 | 20,383 | 8,500 | 7,000 | 123,706 |
| 1885..... | 9 | 89,617 | 12,900 | | | 6,000 | 108,517 |
| 1886..... | 16 | 99,177 | 37,587 | 15,000 | | 1,200 | 152,964 |
| 1887..... | 20 | 130,088 | 58,592 | 11,203 | | 4,200 | 204,083 |
| 1888..... | 21 | 76,616 | 70,106 | 20,000 | 12,318 | 5,000 | 184,040 |
| 1889..... | 28 | 310,122 | 58,405 | 21,722 | 19,800 | 7,162 | 417,211 |
| 1890..... | 33 | 245,352 | 91,645 | 33,500 | 24,700 | 17,000 | 411,257 |
| 1891..... | 38 | 177,989 | 77,057 | 36,500 | 11,058 | 11,907 | 314,511 |
| 1892..... | 36 | 95,491 | 90,750 | 14,955 | 26,100 | 18,425 | 248,721 |
| 1893..... | 44 | 474,237 | 59,021 | 35,416 | 15,680 | 25,848 | 610,202 |
| 1894..... | 42 | 363,566 | 61,005 | 40,161 | 20,000 | 7,500 | 492,232 |
| 1895..... | 49 | 432,920 | 69,356 | 58,575 | 20,541 | 6,300 | 587,692 |
| 1896..... | 56 | 375,344 | 97,863 | 107,473 | 14,649 | 22,453 | 617,782 |
| 1897..... | 65 | 879,776 | 61,310 | 40,090 | 20,000 | 26,007 | 1,027,183 |
| 1898..... | 67 | 264,225 | 80,102 | 105,362 | 20,000 | 22,862 | 492,551 |
| 1899..... | 68 | 527,396 | 112,562 | 76,425 | 19,442 | 29,691 | 765,519 |
| 1900..... | 69 | 331,371 | 135,424 | 74,196 | 20,200 | 45,349 | 606,540 |
| 1901..... | 78 | 995,913 | 125,845 | 66,794 | 15,004 | 40,656 | 1,247,212 |
| 1902..... | 69 | 327,197 | 155,936 | 70,298 | 23,212 | 50,518 | 627,161 |
| 1903..... | 81 | 237,125 | 98,069 | 69,390 | 12,100 | 56,390 | 473,674 |
| 1904..... | 51 | 128,903 | 154,869 | 94,292 | 19,085 | 68,745 | 465,894 |
| 1905..... | 64 | 877,136 | 114,085 | 83,122 | 32,725 | 60,392 | 1,167,460 |
| 1906..... | 59 | 240,466 | 162,420 | 122,878 | 32,534 | 71,142 | 629,460 |
| 1907..... | 42 | 163,116 | 159,255 | 94,064 | 31,832 | 90,192 | 547,459 |
| 1908..... | 50 | 89,184 | 209,177 | 75,090 | 46,908 | 122,330 | 542,689 |
| 1909..... | 56 | 567,203 | 140,739 | 91,014 | 40,590 | 127,974 | 967,920 |
| 1910..... | 58 | 223,148 | 222,035 | 129,398 | 39,720 | 147,900 | 762,201 |
| 1911..... | 59 | 301,344 | 264,410 | 101,066 | 65,634 | 226,461 | 948,965 |
| 1912..... | 57 | 173,921 | 254,258 | 137,697 | 71,162 | 359,533 | 996,576 |
| 1913..... | 78 | 782,059 | 164,055 | 68,096 | 53,423 | 336,268 | 1,353,901 |
| 1914..... | 63 | 328,390 | 237,634 | 109,052 | 94,890 | 341,073 | 1,111,039 |
| 1915..... | 63 | 280,199 | 279,161 | 146,935 | 104,289 | 313,894 | 1,133,381 |
| 1916..... | 73 | 106,440 | 223,158 | 85,383 | 126,686 | 453,398 | 995,066 |
| 1917..... | 90 | 377,988 | 292,219 | 95,302 | 119,495 | 672,481 | 1,557,485 |
| 1918..... | 83 | 206,003 | 374,216 | 103,135 | 148,908 | 788,875 | 1,616,157 |
| 1919..... | 74 | 158,718 | 398,877 | 80,367 | 97,512 | 687,682 | 1,393,166 |
| Total..... | | 12,119,943 | 5,367,525 | 2,550,675 | 1,440,047 | 5,275,373 | 26,753,503 |

NUMBER OF SALMON CANNERIES OPERATED IN VARIOUS SECTIONS OF BRITISH COLUMBIA IN RECENT YEARS.

| Year. | Fraser River. | Naas River. | Skeena River. | Rivers Inlet. | Outlying districts. | Total. |
|-----------|---------------|-------------|---------------|---------------|---------------------|--------|
| 1910..... | 23 | 4 | 12 | 7 | 12 | 58 |
| 1911..... | 22 | 4 | 12 | 7 | 14 | 59 |
| 1912..... | 18 | 4 | 12 | 7 | 16 | 57 |
| 1913..... | 36 | 4 | 13 | 7 | 18 | 78 |
| 1914..... | 21 | 5 | 13 | 7 | 17 | 63 |
| 1915..... | 22 | 5 | 13 | 7 | 16 | 63 |
| 1916..... | 23 | 5 | 14 | 8 | 23 | 73 |
| 1917..... | 29 | 6 | 14 | 9 | 32 | 90 |
| 1918..... | 16 | 7 | 15 | 9 | 36 | 83 |
| 1919..... | 11 | 7 | 16 | 9 | 32 | 74 |

PACK, BY DISTRICTS AND SPECIES, OF CANNED SALMON IN BRITISH COLUMBIA FROM 1903 ^a TO 1919.

| Districts and species. | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 |
|-------------------------------|---------------|---------------|---------------|---------------------|----------------------|---------------------|
| Fraser River district: | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> |
| Chums..... | | 1,666 | | | | |
| Cohos..... | 25,728 | 45,667 | 30,836 | 34,413 | 35,766 | 24,198 |
| Pinks..... | 4,504 | | 3,304 | 15,543 | 63,530 | 415 |
| Sockeyes..... | 204,809 | 72,688 | 837,489 | 183,007 | 59,815 | 63,126 |
| Springs, red..... | 2,084 | 9,482 | 5,507 | 6,503 | 3,448 | 1,427 |
| Springs, white..... | | | | 1,020 | 557 | 18 |
| Total..... | 237,125 | 128,903 | 877,136 | 240,486 | 163,116 | 89,184 |
| Skeena River district: | | | | | | |
| Chums..... | | 35,320 | | | | |
| Cohos..... | 9,648 | 5,515 | 7,247 | 16,897 | 15,247 | 10,085 |
| Pinks..... | 20,045 | | 7,523 | 38,991 | 25,217 | 45,404 |
| Sockeyes..... | 50,968 | 93,404 | 84,717 | 86,394 | 108,413 | 139,846 |
| Springs, red..... | 18,008 | 20,621 | 14,598 | 20,138 | 10,378 | 13,374 |
| Springs, white..... | | | | | | 468 |
| Total..... | 98,669 | 154,860 | 114,085 | 162,420 | 159,255 | 209,177 |
| Rivers Inlet district: | | | | | | |
| Chums..... | | 61 | | | | |
| Cohos..... | 219 | 358 | | 66 | 5,040 | 9,505 |
| Pinks..... | 180 | | | | 700 | 479 |
| Sockeyes..... | 68,119 | 93,862 | 82,771 | 122,631 | 87,874 | 64,652 |
| Springs, red..... | 872 | 11 | 351 | 181 | 450 | 454 |
| Total..... | 69,390 | 94,292 | 83,122 | 122,878 | 94,064 | 75,090 |
| Naas River district: | | | | | | |
| Chums..... | | 31 | | | | |
| Cohos..... | 2,187 | 1,697 | 3,083 | 5,997 | 6,093 | 8,348 |
| Pinks..... | | | 1,840 | 3,450 | 5,957 | 6,612 |
| Sockeyes..... | 8,438 | 15,000 | 24,462 | 22,166 | 17,813 | 27,584 |
| Springs, red..... | 1,475 | 2,357 | 3,340 | 858 | 1,288 | 3,263 |
| Springs, white..... | | | | 63 | | |
| Steelheads..... | | | | | 681 | 1,101 |
| Total..... | 12,100 | 19,085 | 32,725 | 32,534 | 31,832 | 46,908 |
| Outlying districts: | | | | | | |
| Chums..... | | 1,155 | | | | |
| Cohos..... | 14,136 | 13,114 | 3,292 | 11,759 | 25,754 | 29,781 |
| Pinks..... | 2,633 | | 1,303 | 10,721 | 23,300 | 23,538 |
| Sockeyes..... | 36,383 | 48,272 | 51,234 | 45,481 | 40,159 | 59,815 |
| Springs, red..... | 3,218 | 6,204 | 4,563 | 3,581 | 7,595 | 6,915 |
| Springs, white..... | | | | | 2,382 | 2,215 |
| Steelheads..... | | | | | 2 | 36 |
| Total..... | 56,390 | 68,745 | 60,392 | 71,142 | 99,192 | 122,330 |
| TOTAL BY SPECIES. | | | | | | |
| Chums..... | | 37,642 | | | | |
| Cohos..... | 51,918 | 66,351 | 44,458 | 69,132 | 87,900 | 81,917 |
| Pinks..... | 27,382 | | 13,970 | ^b 68,305 | ^b 118,704 | ^b 76,448 |
| Sockeyes..... | 368,717 | 323,226 | 1,080,673 | 459,679 | 314,074 | 355,023 |
| Springs, red..... | 25,657 | 38,675 | 28,359 | 31,261 | 23,159 | 25,433 |
| Springs, white..... | | | | 1,083 | 2,939 | 2,731 |
| Steelheads..... | | | | | 683 | 1,137 |
| Grand total..... | 473,674 | 465,894 | 1,167,460 | 629,460 | 547,459 | 542,689 |

^a In 1901 in the Fraser River district 920,313 cases of sockeyes were packed, and in 1902 sockeyes were packed as follows: 293,477 cases in Fraser River district, 117,677 cases in Skeena River district, 68,819 cases in Rivers Inlet district, 20,953 cases in Naas River district, and 30,510 cases in outlying districts.

^b Pinks and chums combined.

PACK, BY DISTRICTS AND SPECIES, OF CANNED SALMON IN BRITISH COLUMBIA FROM 1903 TO 1919—Continued.

| District and species. | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 |
|-------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Fraser River district: | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> |
| Chums..... | | 52,177 | 47,237 | 12,961 | 22,220 | 74,726 |
| Cohos..... | 21,540 | 27,855 | 39,740 | 28,574 | 11,648 | 38,639 |
| Pinks..... | 1,987 | 128 | 142,101 | 574 | 9,973 | 6,057 |
| Sockeyes..... | 542,248 | 133,045 | 58,487 | 108,784 | 684,596 | 185,483 |
| Springs, red..... | 1,428 | 1,018 | 7,028 | 14,655 | 3,573 | 9,485 |
| Springs, white..... | | 8,925 | 6,751 | 8,373 | 49 | 14,000 |
| Total..... | 567,293 | 223,148 | 301,344 | 173,921 | 732,059 | 328,390 |
| Skeena River district: | | | | | | |
| Chums..... | | | 70 | 504 | | 8,320 |
| Cohos..... | 12,249 | 11,531 | 23,376 | 39,628 | 18,647 | 16,788 |
| Pinks..... | 38,120 | 13,473 | 81,956 | 97,588 | 66,045 | 71,021 |
| Sockeyes..... | 87,901 | 187,246 | 131,066 | 92,498 | 52,927 | 130,166 |
| Springs, red..... | 11,727 | 9,546 | 15,514 | 19,332 | 23,250 | 11,529 |
| Springs, white..... | 742 | 299 | 2,428 | 4,501 | 3,186 | 211 |
| Steelheads..... | | | | 297 | | |
| Total..... | 149,739 | 222,035 | 254,410 | 254,258 | 164,055 | 287,634 |
| Rivers Inlet district: | | | | | | |
| Chums..... | | | 288 | 3,845 | | 5,023 |
| Cohos..... | 1,460 | 2,075 | 6,287 | 11,010 | 3,660 | 7,789 |
| Pinks..... | | 19 | 5,411 | 8,809 | 2,097 | 5,784 |
| Sockeyes..... | 89,027 | 126,921 | 88,763 | 112,884 | 61,745 | 89,890 |
| Springs, red..... | 587 | 383 | 317 | 681 | 594 | 566 |
| Springs, white..... | | | | 468 | | |
| Total..... | 91,014 | 129,398 | 101,066 | 137,697 | 68,096 | 109,052 |
| Naas River district: | | | | | | |
| Chums..... | | 351 | 5,189 | 3,245 | 2,987 | 25,569 |
| Cohos..... | 6,818 | 6,285 | 7,842 | 12,468 | 3,172 | 9,276 |
| Pinks..... | 3,589 | 895 | 11,467 | 12,476 | 20,539 | 25,333 |
| Sockeyes..... | 28,246 | 30,810 | 37,327 | 36,037 | 23,574 | 31,327 |
| Springs, red..... | 2,280 | 1,228 | 3,434 | 5,710 | 2,999 | 2,660 |
| Springs, white..... | 57 | 11 | 325 | 1,226 | 152 | 725 |
| Steelheads..... | | 140 | 190 | | | |
| Total..... | 40,000 | 39,720 | 65,684 | 71,102 | 53,423 | 94,890 |
| Outlying districts: | | | | | | |
| Chums..... | | 5,834 | 39,167 | 37,770 | 52,758 | 70,827 |
| Cohos..... | 19,911 | 26,636 | 42,457 | 73,422 | 32,695 | 48,119 |
| Pinks..... | 12,848 | 20,098 | 64,312 | 128,296 | 94,233 | 112,145 |
| Sockeyes..... | 93,019 | 87,893 | 67,866 | 94,559 | 149,336 | 99,830 |
| Springs, red..... | 2,196 | 7,138 | 12,458 | 21,967 | 7,017 | 8,668 |
| Springs, white..... | | 301 | 201 | 3,524 | 269 | 1,484 |
| Total..... | 127,974 | 147,900 | 226,461 | 359,538 | 336,268 | 341,073 |
| TOTAL BY SPECIES. | | | | | | |
| Chums..... | | 58,362 | 91,951 | 58,325 | 77,965 | 184,474 |
| Cohos..... | 61,918 | 74,382 | 119,702 | 165,102 | 69,822 | 120,201 |
| Pinks..... | a 46,544 | 34,613 | 305,247 | 247,743 | 192,887 | 220,340 |
| Sockeyes..... | 840,441 | 565,915 | 383,509 | 444,762 | 972,178 | 536,696 |
| Springs, red..... | 18,218 | 19,313 | 38,751 | 62,345 | 37,433 | 32,908 |
| Springs, white..... | 799 | 9,476 | 9,705 | 18,092 | 3,616 | 16,420 |
| Steelheads..... | | 140 | 100 | 207 | | |
| Grand total..... | 967,920 | 762,201 | 948,965 | 996,576 | 1,353,901 | 1,111,039 |

a Pinks and chums combined.

PACK, BY DISTRICTS AND SPECIES, OF CANNED SALMON IN BRITISH COLUMBIA FROM
1903 TO 1919—Continued.

| District and species. | 1915 | 1916 | 1917 | 1918 | 1919 |
|------------------------|---------------|---------------|---------------|---------------|---------------|
| Fraser River district: | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> |
| Chums..... | 18,539 | 30,184 | 59,973 | 86,215 | 15,718 |
| Cohos..... | 34,114 | 27,676 | 30,735 | 43,871 | 54,866 |
| Pinks..... | 128,555 | 840 | 134,442 | 18,388 | 39,363 |
| Sockeyes..... | 89,040 | 27,394 | 123,614 | 16,849 | 29,628 |
| Springs, red..... | 15,388 | 11,096 | 10,197 | 15,192 | 15,223 |
| Springs, white..... | 3,532 | 9,217 | 18,916 | 24,853 | 3,592 |
| Steelheads..... | 31 | 38 | 111 | 635 | 328 |
| Total..... | 289,199 | 106,440 | 377,988 | 206,003 | 158,718 |
| Skeena River district: | | | | | |
| Chums..... | 5,769 | 17,121 | 21,516 | 22,573 | 31,457 |
| Cohos..... | 32,190 | 47,409 | 38,456 | 38,759 | 36,559 |
| Pinks..... | 107,578 | 73,029 | 148,319 | 161,727 | 117,303 |
| Sockeyes..... | 116,553 | 60,923 | 65,760 | 123,322 | 184,945 |
| Springs, red..... | 15,069 | 18,372 | 13,586 | 16,013 | 23,285 |
| Springs, white..... | 204 | 2,561 | 2,699 | 6,828 | 2,656 |
| Steelheads..... | 1,798 | 3,743 | 1,883 | 4,994 | 2,672 |
| Total..... | 279,161 | 223,158 | 292,219 | 374,216 | 398,877 |
| Rivers Inlet district: | | | | | |
| Chums..... | 5,387 | 20,144 | 16,101 | 6,729 | 7,089 |
| Cohos..... | 7,115 | 15,314 | 9,124 | 12,074 | 9,038 |
| Pinks..... | 2,964 | 3,567 | 8,065 | 29,542 | 6,538 |
| Sockeyes..... | 130,350 | 44,936 | 61,195 | 53,401 | 56,258 |
| Springs, red..... | 1,022 | 1,033 | 715 | 957 | 1,201 |
| Springs, white..... | | 889 | 102 | 452 | 241 |
| Steelheads..... | | | | | 2 |
| Total..... | 146,838 | 85,383 | 95,302 | 103,155 | 80,367 |
| Naas River district: | | | | | |
| Chums..... | 11,076 | 11,200 | 24,938 | 40,368 | 24,041 |
| Cohos..... | 15,171 | 19,139 | 22,180 | 17,061 | 10,900 |
| Pinks..... | 34,879 | 59,593 | 44,568 | 59,206 | 29,949 |
| Sockeyes..... | 39,349 | 31,411 | 22,188 | 21,816 | 28,259 |
| Springs, red..... | 3,053 | 3,061 | 3,170 | 2,332 | 2,993 |
| Springs, white..... | 648 | 784 | 1,326 | 1,820 | 581 |
| Steelheads..... | 113 | 1,498 | 1,125 | 1,305 | 789 |
| Total..... | 104,289 | 126,686 | 119,495 | 143,908 | 97,512 |
| Outlying districts: | | | | | |
| Chums..... | 41,229 | 161,552 | 352,745 | 341,730 | 293,730 |
| Cohos..... | 58,366 | 77,181 | 64,814 | 87,359 | 88,630 |
| Pinks..... | 93,376 | 143,615 | 161,365 | 258,882 | 153,486 |
| Sockeyes..... | 100,750 | 50,125 | 67,091 | 61,071 | 70,355 |
| Springs, red..... | 17,202 | 17,669 | 20,962 | 31,041 | 39,554 |
| Springs, white..... | 1,986 | 2,544 | 4,603 | 7,866 | 11,225 |
| Steelheads..... | 985 | 712 | 901 | 926 | 702 |
| Total..... | 313,894 | 453,398 | 672,481 | 788,875 | 657,682 |
| TOTAL BY SPECIES. | | | | | |
| Chums..... | 82,000 | 240,201 | 475,273 | 497,615 | 372,035 |
| Cohos..... | 146,956 | 186,719 | 165,309 | 199,124 | 199,993 |
| Pinks..... | 367,352 | 280,644 | 496,759 | 527,745 | 346,639 |
| Sockeyes..... | 476,042 | 214,789 | 339,848 | 276,459 | 369,445 |
| Springs, red..... | 51,734 | 51,231 | 48,630 | 65,535 | 82,256 |
| Springs, white..... | 6,370 | 15,495 | 27,646 | 41,819 | 18,295 |
| Steelheads..... | 2,927 | 5,986 | 4,020 | 7,860 | 4,493 |
| Grand total..... | 1,133,381 | 995,065 | 1,557,485 | 1,616,157 | 1,393,156 |

MARKET PRICES FOR CANNED SALMON.

The manner of fixing the selling price at which the canner is willing to dispose of his canned product varies slightly in certain regions. In May or June, when the spring-packing season has sufficiently advanced so that a line can be gotten on the probable pack of chinook, the highest priced of the pack, the Columbia River canners agree upon a price, this usually being high or low, as the pack is small or large.

Since the Alaska Packers Association was formed, through a combination of a number of canneries operating in the Territory of Alaska, it has packed annually in recent years about one-fourth of the salmon canned. It also owns several canneries on Puget Sound, thus being quite a factor in that region also.

In the early days of the association the custom grew up amongst the smaller packers of Alaska and Puget Sound of waiting until the association fixed the prices on its own pack, when the others would generally fall into line with the same prices for their packs. This custom is still in vogue. At no time has it ever been compulsory on the part of any packer to adopt the same prices as the association. In fact, it has sometimes been the case that, while the small packer publicly quoted the association's opening prices, yet in secret he was shading it by 2½ to 5 cents per dozen on certain grades. In recent years this has frequently been the case and the big packers, who adhered to the opening prices, have had to sit idly by and watch their small competitors underselling them and getting the bulk of the business until they had finally disposed of their goods, when, necessarily, they would have to drop out of the market until the next season.

Occasionally the other packers do not like a certain quotation of the association and make one more nearly in consonance with their own views. This happened in 1913, when the association quoted 60 cents for chums, while the Puget Sound canners quoted 55 cents for this grade, and in 1915 when the association quoted 65 cents for chums and the Puget Sound interests 70 cents for the same grade, thus showing clearly the independence of the smaller packers.

Owing to a peculiar feature of the salmon marketing business, more depends upon the opening prices than appears on the surface to the uninitiated.

Shortly after the first of the year buyers throughout the world begin to take stock of their salmon supplies and shortly thereafter begin placing their "future" orders. These cover the quantity required of each grade, and when the buyer orders through a broker the orders are placed subject to a contract similar to the following:

The undersigned hereby authorizes ——— to book the number of cases of canned salmon specified below, said booking to be filed with packers for delivery from ——— (naming year) pack, subject to buyers' approval of opening prices when named; *the option being granted buyers of confirming the total number of cases specified below; confirming a smaller quantity, or declining any confirmation.*

——— furthermore agrees that buyers shall have the option of increasing quantities listed below, when he names opening prices for his packers, contingent upon his ability to secure at that time an increased allotment from his packers. In event ——— secures an increased allotment from his packers insufficient to meet all increases requested by his patrons, he will distribute such increase as he can secure among the dealers who have filed conditional contracts with him, according to the date order that said contracts have been received in his office.

Under this form of contract the packer is expected to be ready to fulfill the terms of same, except in case of a short pack, when the orders are generally prorated; i. e., all orders are proportionately reduced until they come within the compass of the pack. Should the buyer dislike the opening price he has the privilege of canceling the order. While this latter privilege may not, at first glance, look just to the packer, yet it is doubtful if any buyer would place a "future" order unless he was assured of a chance to cancel it should he feel that too high a sum was fixed in the opening prices.

Some canneries contract to sell their entire output to one buyer, and the price fixed is usually the opening prices for the year in question. In such cases the buyer and seller are both compelled to abide by the price, no matter how unjust one or the other may consider it.

The association does not announce its opening prices until late in August or early in September, when the greater part of the packing is over with and a good line on the total pack has been obtained, and it speaks well for the discernment of the officials of the association that their judgment as to prices should meet with the general approval as often as it does.

AMERICAN OPENING PRICES.

Below are shown the yearly opening prices on the various grades and sizes from 1890 to 1919. The most interesting part of this is the increase shown in the value of high-grade salmon. Columbia River chinook was quoted at \$1.05 for 1-pound talls in 1897, and it gradually advances until in 1919 it is quoted at \$3.15. Alaska red 1-pound talls in 1897 sold for 90 cents, the lowest during the period in question, advancing, with occasional recessions, until in 1919 it reached high-water mark of \$3.25. In 1897 Puget Sound 1-pound tall sockeye sold for 80 cents, 10 cents below Alaska red. In 1898 it sold for 20 cents less than reds. In 1902 it sold for \$1 as compared with 95 cents for Alaska red, and from that time on brought a higher price, being quoted at \$3.15 in 1919 as compared with \$2.35 for Alaska red. No sockeye 1-pound talls were packed in 1919.

Medium red or coho does not figure in the opening prices until 1908, when Puget Sound coho sold for 5 cents a dozen more than Alaska coho. Very shortly thereafter, however, both were classed together and sold for the same price. This grade has not had the wide fluctuations of the others, due mainly to the generally small pack made annually.

Pink salmon has been the football of the salmon market ever since the pack became of sufficient size to become a feature in it. The size of the pack has been steadily increasing, as the fish became better known, and while the price obtained has been excellent in certain years (in 1911 it sold at \$1 per dozen, the highest point reached up to that time, usually the price has been low. In 1897 it was quoted at 65 cents. In 1915 the opening price was 75 cents, but as a matter of fact a large part of the pack really sold for 65 cents. The lowest point it reached was in 1903, when it was quoted at 50 cents a dozen. As a result of the demand created by the war pink salmon opened at 90 cents in 1916, \$1.65 in 1917 and 1918, and \$2.25 in 1919. The market collapsed under the last-named price, however, and is now (1920) not more than one-half of it.

It is only of recent years that chum salmon has become a factor in the market. Although sold for some time before then, chum salmon appears first in the regular opening prices in 1908, when it was quoted at 70 cents a dozen. In 1913 it was quoted at 55 cents while the opening price in 1915 was 70 cents on Puget Sound and 65 cents at San Francisco. During the war the opening prices on chums were materially increased, being 85 cents in 1916, \$1.60 in 1917, \$1.75 in 1918, and \$2.15 in 1919. As in the case of chums the market collapsed under the 1919 price, and some sales under \$1 were made in 1920.

The pack of Alaska and Puget Sound kings or springs has always been small, and while they have always been quoted at \$1 per dozen or better (in 1919 they were quoted at \$3.12½) they have always been slow sellers. It is extremely improbable that the canned pack will increase much in the future, as this fish is the best for mild curing, and as the mild curers are able to offer better prices for the raw fish than the canneries, they will always get the fish when desired.

AMERICAN OPENING PRICES PER DOZEN CANS SINCE 1890.

1890 to 1902.

| Year and species. | Talls. | Year and species. | Talls. | Year and species. | Talls. |
|------------------------|--------|------------------------|---------|------------------------|--------|
| 1890. | | 1895. | | 1899. | |
| Columbia River chinook | \$1.40 | Columbia River chinook | \$1.32½ | Columbia River chinook | \$1.25 |
| Alaska red | 1.20 | Alaska red | 1.15 | Alaska red | 1.10 |
| Alaska pink | .75 | Alaska pink | .80 | Puget Sound sockeye | 1.10 |
| 1891. | | 1896. | | Alaska pink | .67½ |
| Columbia River chinook | 1.35 | 1896. | | 1900. | |
| Alaska red | 1.20 | Columbia River chinook | 1.25 | Columbia River chinook | 1.60 |
| Alaska pink | .75 | Alaska red | 1.10 | Alaska red | 1.25 |
| 1892. | | Alaska pink | .75 | Puget Sound sockeye | 1.10 |
| Columbia River chinook | 1.35 | 1897. | | Alaska pink | .75 |
| Alaska red | 1.15 | Columbia River chinook | 1.05 | 1901. | |
| Alaska pink | .75 | Alaska red | .95 | Columbia River chinook | 1.50 |
| 1893. | | Puget Sound sockeye | .80 | Alaska red | 1.25 |
| Columbia River chinook | 1.32½ | Alaska pink | .65 | Puget Sound sockeye | .95 |
| Alaska red | 1.17½ | 1898. | | Alaska pink | .75 |
| Alaska pink | .65 | Columbia River chinook | 1.05 | 1902. | |
| 1894. | | Alaska red | .97½ | Columbia River chinook | 1.35 |
| Columbia River chinook | 1.35 | Puget Sound sockeye | .80 | Alaska red | 1.00 |
| Alaska red | 1.10 | Alaska pink | .65 | Puget Sound sockeye | 1.00 |
| Alaska pink | .60 | | | Alaska pink | .65 |

1903 to 1919.

| Year and species. | Talls. | Flats. | Halves. | Year and species. | Talls. | Flats. | Halves. |
|------------------------|--------|--------|---------|------------------------|--------|--------|---------|
| 1903. | | | | 1905. | | | |
| Puget Sound sockeye | \$1.50 | \$1.60 | \$0.90 | Columbia River chinook | \$1.45 | \$1.55 | \$0.90 |
| Columbia River chinook | 1.35 | 1.45 | .85 | Puget Sound sockeye | 1.35 | 1.50 | 1.00 |
| Alaska red | 1.30 | | | Alaska red | 1.00 | | |
| Alaska pink | .50 | | | Alaska pink | .70 | | |
| 1904. | | | | 1906. | | | |
| Columbia River chinook | 1.45 | 1.15 | .90 | Columbia River chinook | 1.50 | 1.60 | 1.00 |
| Puget Sound sockeye | 1.55 | 1.65 | .95 | Puget Sound sockeye | 1.45 | 1.60 | 1.00 |
| Alaska red | 1.30 | | | Alaska red | .95 | | |
| Alaska pink | .70 | | | Alaska pink | .75 | | |

AMERICAN OPENING PRICES PER DOZEN CANS SINCE 1890—Continued.

1903 to 1919—Continued.

| Year and species. | Tails. | Flats. | Halves. | Year and species. | Tails. | Flats. | Halves. |
|-----------------------------|--------|--------|---------|-----------------------|--------|--------|---------|
| 1907. | | | | 1913 | | | |
| Columbia River chinook..... | \$1.65 | \$1.75 | \$1.05 | Pink..... | \$0.65 | \$0.80 | \$0.55 |
| Puget Sound sockeye..... | 1.60 | 1.75 | 1.10 | Chum..... | a.55 | .70 | .50 |
| Alaska red..... | 1.15 | | | | | | |
| Alaska pink..... | .80 | | | 1914. | | | |
| 1908. | | | | Chinook..... | 1.95 | 2.10 | 1.25 |
| Columbia River chinook..... | 1.65 | 1.75 | 1.05 | Sockeye..... | 1.95 | 2.15 | 1.35 |
| Puget Sound sockeye..... | 1.60 | 1.75 | 1.05 | Alaska red..... | 1.45 | 1.80 | 1.10 |
| Puget Sound pink..... | .75 | .80 | | Medium red..... | 1.15 | 1.35 | .82½ |
| Puget Sound coho..... | 1.05 | 1.15 | .75 | Alaska king..... | 1.40 | | 1.10 |
| Alaska red..... | 1.15 | | | Pink..... | .90 | 1.00 | .70 |
| Alaska king..... | 1.05 | | | Keta, or chum..... | .85 | .95 | .65 |
| Alaska coho..... | 1.00 | | | 1915. | | | |
| Alaska pink..... | .70 | | | Chinook..... | 1.90 | 2.00 | 1.25 |
| Alaska chum..... | .70 | | | Sockeye..... | 1.95 | 2.15 | 1.35 |
| 1909. | | | | Alaska red..... | 1.50 | 1.85 | 1.15 |
| Columbia River chinook, | | | | Medium red..... | 1.15 | 1.30 | .75 |
| fancy..... | 1.65 | 1.75 | 1.05 | Alaska king..... | 1.25 | | |
| Puget Sound sockeye..... | 1.35 | 1.50 | 1.00 | Pink..... | .75 | .85 | .57½ |
| Alaska red..... | 1.15 | 1.35 | .85 | Keta, or chum..... | b.70 | .80 | .52½ |
| Alaska king..... | 1.10 | | | 1916. ^c | | | |
| Alaska coho..... | 1.05 | 1.20 | .70 | Chinook..... | 1.90 | 2.00 | 1.25 |
| Alaska pink..... | .60 | | | Sockeye..... | 2.05 | 2.25 | 1.40 |
| Alaska chum..... | .57½ | | | Alaska red..... | 1.50 | 1.75 | 1.20 |
| 1910. | | | | Medium red..... | 1.30 | 1.45 | .90 |
| Columbia River chinook, | | | | Alaska king..... | 1.35 | | |
| fancy..... | 1.75 | 1.90 | 1.10 | Pink..... | .90 | 1.10 | .75 |
| Puget Sound sockeye..... | 1.65 | 1.80 | 1.10 | Chum..... | .85 | | .67½ |
| Alaska red..... | 1.35 | 1.50 | 1.00 | 1917. | | | |
| Alaska king..... | 1.35 | | | Chinook..... | 2.90 | 3.00 | 1.75 |
| Alaska pink..... | .80 | | | Sockeye..... | 2.90 | 3.00 | 1.75 |
| Alaska chum..... | .77½ | | | Alaska red..... | 2.35 | 2.60 | 1.65 |
| Medium red and coho..... | 1.25 | 1.40 | .80 | Medium red..... | 2.00 | 2.15 | 1.35 |
| 1911. | | | | Alaska king..... | 2.25 | | |
| Columbia River chinook, | | | | Pink..... | 1.65 | 1.80 | 1.15 |
| fancy..... | 1.95 | 2.00 | 1.30 | Chum..... | 1.60 | 1.75 | |
| Puget Sound sockeye..... | 1.95 | 2.00 | 1.30 | 1918. ^d | | | |
| Alaska red..... | 1.60 | 1.75 | 1.12½ | Chinook: | | | |
| Alaska medium red..... | 1.45 | 1.65 | 1.00 | Fancy..... | 3.15 | 3.25 | 2.00 |
| Alaska king..... | 1.80 | 2.00 | 1.12½ | Standard..... | 2.75 | 2.85 | 1.75 |
| Pink..... | 1.00 | 1.15 | .80 | Bluebacks..... | | | 2.00 |
| Chum..... | .95 | 1.05 | .75 | Sockeye..... | 3.15 | e3.25 | 2.00 |
| 1912. | | | | Alaska red..... | 2.35 | 2.50 | 1.65 |
| Chinook..... | 1.95 | 2.00 | 1.25 | Medium red: | | | |
| Sockeye..... | 1.95 | 2.00 | 1.30 | Alaska..... | 2.25 | 2.40 | 1.60 |
| Alaska red..... | 1.40 | 1.60 | 1.15 | Puget Sound, etc..... | 2.40 | 2.50 | 1.60 |
| Alaska medium red..... | 1.15 | 1.25 | .80 | Pink..... | 1.65 | 1.80 | 1.15 |
| Alaska king..... | 1.40 | 1.60 | 1.15 | Chum: | | | |
| Pink..... | .65 | .65 | .55 | Alaska..... | 1.60 | 1.75 | 1.10 |
| Chum..... | .62½ | | .50 | Puget Sound, etc..... | 1.75 | 1.85 | 1.10 |
| 1913. | | | | Steelhead..... | 3.00 | 3.10 | 1.90 |
| Chinook..... | 1.95 | 2.00 | 1.25 | 1919. | | | |
| Sockeye..... | 1.50 | 1.65 | 1.05 | Chinook..... | 3.15 | 3.25 | 2.00 |
| Alaska red..... | 1.15 | 1.35 | .95 | Sockeye..... | | | f2.50 |
| Alaska medium red..... | .85 | 1.00 | .70 | Alaska red..... | 3.35 | 3.50 | 2.25 |
| Alaska king..... | 1.00 | 1.15 | .90 | Tips and tails..... | 3.10 | | |
| | | | | Alaska king..... | 3.12½ | | |
| | | | | Medium red..... | 3.00 | 3.15 | 2.00 |
| | | | | Pink..... | 2.25 | 2.40 | 1.40 |
| | | | | Chum..... | 2.15 | 2.30 | 1.25 |

^a The opening price in San Francisco was 60 cents.^b The opening price in San Francisco was 65 cents.^c The Kelley-Clarke prices differed from these in the following particulars: Red tails, \$1.60; red halves, \$1.25; medium red tails, \$1.35; medium red flats, \$1.50; medium red halves, \$1.00; pink tails, \$1.00; Chum tails, 95c.; and King tails, \$1.40.^d Maximum prices set by U. S. Food Administration.^e Pack of 1-pound tails and 1-pound flats taken for British Government at these prices.^f No price named by Alaska Packers Association or Deming & Gould Co.^g Alaska Packers Association and Northwestern Fisheries Co. Quoted \$3.25; others reduced to conform.^h Quoted by Alaska Packers Association only.ⁱ Alaska Packers Association quoted \$2.10.

BRITISH COLUMBIA OPENING PRICES.

The packers of British Columbia and the United States both sell a considerable portion of their high-grade salmon abroad, and the competition thus engendered compels a fairly close conformity in prices. On salmon sold in the domestic markets, however, the competition is not so keen; hence there is room for a considerable diversity of opinion as to values. Unlike the United States, there is a very small market in Canada for chum salmon, and it has only been in recent years that opening prices have been fixed on this grade.

BRITISH COLUMBIA OPENING PRICES SINCE 1902.^a

[Prices are for full cases.]

| Year and species. | Tails. | Flats. | Halves. | Year and species. | Tails. | Flats. | Halves. |
|-------------------|--------|--------|---------|-------------------|--------|--------|---------|
| 1902. | | | | 1911. | | | |
| Sockeye..... | \$4.75 | \$4.90 | | Pink..... | \$4.00 | \$4.25 | \$5.50 |
| Red spring..... | 4.00 | | | Chum..... | 3.75 | | |
| Coho..... | 3.75 | | | | | | |
| Pink..... | 2.50 | 2.50 | | 1912. | | | |
| 1903. | | | | Sockeye..... | 9.00 | 9.25 | 10.75 |
| Sockeye..... | 4.65 | | | Red spring..... | 7.75 | | 9.25 |
| Red spring..... | 4.00 | | | Coho..... | 7.25 | 7.25 | 7.50 |
| Coho..... | 3.75 | | | Pink..... | 3.00 | 3.00 | 4.50 |
| Pink..... | 2.00 | 2.50 | | Chum..... | 2.75 | | |
| 1904. | | | | 1913. | | | |
| Sockeye..... | 5.75 | 6.25 | | Sockeye..... | 6.00 | 6.25 | 7.75 |
| Red spring..... | 5.25 | | | Red spring..... | 5.75 | 5.75 | |
| Coho..... | 4.25 | | | Coho..... | 4.25 | 4.50 | |
| Pink..... | 2.75 | | | Pink..... | 2.50 | 2.50 | |
| 1905. | | | | 1914. | | | |
| Sockeye..... | 5.00 | 5.30 | | Sockeye..... | 7.50 | 8.75 | 9.25 |
| Red spring..... | 4.50 | 5.00 | | Red spring..... | 6.75 | | |
| Coho..... | 4.00 | | | Coho..... | 4.75 | | 5.50 |
| Pink..... | 2.00 | | | Pink..... | 3.50 | | |
| 1906. | | | | 1915. | | | |
| Sockeye..... | 5.50 | | | Sockeye..... | 8.25 | 8.25 | 10.25 |
| Red spring..... | 5.25 | | | Red spring..... | 6.75 | | |
| Coho..... | 4.50 | 4.75 | | Coho..... | 4.50 | 5.00 | |
| Pink..... | | 3.00 | | Pink..... | 3.25 | 3.50 | 4.75 |
| 1907. | | | | Chum..... | 2.75 | | |
| Sockeye..... | 5.50 | | | 1916. | | | |
| Red spring..... | 5.50 | 5.50 | | Sockeye..... | 9.00 | | 11.00 |
| Coho..... | 4.50 | 4.50 | | Red spring..... | 8.00 | | 9.50 |
| Pink..... | 3.00 | 3.00 | | Coho..... | 6.50 | | 9.00 |
| 1908. | | | | Pink..... | 3.75 | | 5.25 |
| Sockeye..... | 6.10 | | | Chum..... | 3.00 | 4.00 | |
| Red spring..... | 5.75 | 5.75 | | 1917. | | | |
| Coho..... | 4.75 | 5.00 | | Sockeye..... | 13.00 | | 16.00 |
| Pink..... | 3.25 | 3.25 | | Red spring..... | | 12.00 | 13.00 |
| 1909. | | | | Coho..... | 10.00 | 11.00 | 12.50 |
| Sockeye..... | 5.25 | | \$6.75 | Pink..... | 8.00 | | 9.25 |
| Red spring..... | 5.10 | 5.60 | | Chum..... | 6.65 | | |
| Coho..... | 4.25 | | | 1918. | | | |
| Pink..... | 2.75 | | | Sockeye..... | 14.50 | 15.00 | 16.00 |
| 1910. | | | | Red spring..... | 13.00 | 13.25 | 14.00 |
| Sockeye..... | 6.50 | 7.00 | 8.25 | Coho..... | 11.50 | 12.00 | 13.00 |
| Red spring..... | 5.75 | 6.00 | | Pink..... | 8.50 | 8.75 | 10.00 |
| Coho..... | 5.00 | 5.50 | 6.50 | Chum..... | 6.75 | | 7.75 |
| Pink..... | 3.25 | | | 1919. | | | |
| 1911. | | | | Sockeye..... | 16.00 | 16.50 | 17.50 |
| Sockeye..... | 7.75 | 8.00 | 10.00 | Red spring..... | | | 16.00 |
| Red spring..... | 6.50 | | | Coho..... | 12.00 | 12.50 | 13.50 |
| Coho..... | 6.00 | 6.25 | 7.50 | Pink..... | | 9.00 | 10.00 |
| | | | | Chum..... | 6.75 | | |

^a These opening prices have been furnished by H. Bell Irving & Co. (Ltd.), of Vancouver, British Columbia, Canada, well known packers and handlers of canned salmon.

PICKLING INDUSTRY.

The salmon-pickling industry was so overshadowed by its giant brother, the canning industry, that statistical data, except for Alaska, were found in extremely fragmentary shape, and only that portion is shown relating to Alaska from the time of annexation to and including 1919.

PACK OF SALTED SALMON IN ALASKA, 1868 TO 1919.

| Year. | Salmon. | | Salmon bellies. | | Dry-salted salmon. | |
|------------|----------|-----------|-----------------|---------|--------------------|----------|
| | Barrels. | Value. | Barrels. | Value. | Pounds. | Value. |
| 1868..... | 2,000 | \$16,000 | | | | |
| 1869..... | 1,700 | 13,600 | | | | |
| 1870..... | 1,800 | 14,400 | | | | |
| 1871..... | 700 | 6,300 | | | | |
| 1872..... | 1,000 | 9,000 | | | | |
| 1873..... | 900 | 7,200 | | | | |
| 1874..... | 1,400 | 11,200 | | | | |
| 1875..... | 1,200 | 9,600 | | | | |
| 1876..... | 1,800 | 14,400 | | | | |
| 1877..... | 1,950 | 15,700 | | | | |
| 1878..... | 2,100 | 16,800 | | | | |
| 1879..... | 3,500 | 28,000 | | | | |
| 1880..... | 3,700 | 29,600 | 300 | \$3,300 | | |
| 1881..... | 1,760 | 15,840 | | | | |
| 1882..... | 5,890 | 53,010 | | | | |
| 1883..... | 7,251 | 65,259 | | | | |
| 1884..... | 6,106 | 54,954 | | | | |
| 1885..... | 3,230 | 29,070 | | | | |
| 1886..... | 4,861 | 43,749 | | | | |
| 1887..... | 3,978 | 35,802 | | | | |
| 1888..... | 9,500 | 85,500 | | | | |
| 1889..... | 6,457 | 58,013 | | | | |
| 1890..... | 18,039 | 162,351 | | | | |
| 1891..... | 8,913 | 71,304 | | | | |
| 1892..... | 17,374 | 140,057 | 53 | \$15 | | |
| 1893..... | 24,005 | 120,083 | | | | |
| 1894..... | 32,011 | 176,060 | | | | |
| 1895..... | 14,234 | 85,404 | | | | |
| 1896..... | 9,314 | 65,198 | 150 | 1,200 | | |
| 1897..... | 15,848 | 110,936 | 2,846 | 28,460 | | |
| 1898..... | 22,670 | 181,360 | 580 | 5,800 | | |
| 1899..... | 22,382 | 167,865 | 235 | 2,350 | | |
| 1900..... | 31,852 | 238,890 | 2,353 | 23,530 | 511,400 | \$10,228 |
| 1901..... | 24,477 | 171,339 | 652 | 3,816 | | |
| 1902..... | 30,384 | 212,688 | 328 | 2,952 | | |
| 1903..... | 27,921 | 223,368 | 3,667 | 32,973 | 300,000 | 5,500 |
| 1904..... | 13,674 | 89,209 | 208 | 1,950 | 966,812 | 16,180 |
| 1905..... | 19,071 | 143,811 | 1,360 | 11,355 | 7,280,234 | 115,643 |
| 1906..... | 17,283 | 126,194 | 1,338 | 13,644 | 1,107,680 | 16,969 |
| 1907..... | 22,307 | 203,127 | 2,965 | 37,422 | 107,580 | 1,505 |
| 1908..... | 34,337 | 293,377 | 4,736 | 59,330 | 20,800 | 416 |
| 1909..... | 28,915 | 183,400 | 1,970 | 25,358 | 71,600 | 1,038 |
| 1910..... | 12,779 | 111,634 | 1,626 | 19,007 | 22,178 | 554 |
| 1911..... | 8,483 | 102,477 | 1,337 | 15,561 | 33,285 | 1,340 |
| 1912..... | 34,602 | 305,928 | 37 | 606 | | |
| 1913..... | 37,881 | 272,726 | 451 | 6,523 | 21,282 | 1,235 |
| 1914..... | 25,954 | 247,195 | 408 | 5,467 | 12,200 | 810 |
| 1915..... | 12,058 | 157,457 | 571 | 13,610 | | |
| 1916..... | 17,259 | 205,706 | 475 | 6,961 | 44,552 | 2,408 |
| 1917..... | 36,165 | 584,962 | 225 | 5,535 | 371,600 | 33,044 |
| 1918..... | 56,837 | 1,078,456 | 53 | 1,425 | | |
| 1919..... | 8,110 | 195,447 | | | 212,244 | 17,601 |
| Total..... | 757,927 | 7,058,006 | 28,924 | 328,950 | 11,083,447 | 224,471 |

ALASKA PICKLED-SALMON PACK, 1906 TO 1918, BY SPECIES, QUANTITY,^a AND VALUE.

| Species. | 1906 | | 1907 | | 1908 | | 1909 | | 1910 | |
|----------------|----------|---------|----------|----------|----------|---------|----------|---------|----------|---------|
| | Barrels. | Value. | Barrels. | Value. | Barrels. | Value. | Barrels. | Value. | Barrels. | Value. |
| Whole salmon: | | | | | | | | | | |
| Coho..... | 539 | \$5,642 | 1,665 | \$16,406 | 692 | \$5,648 | 318 | \$2,485 | 160 | \$1,504 |
| Chum..... | 231 | 1,550 | 233 | 1,521 | 122 | 707 | 35 | 190 | 330 | 1,998 |
| Humpback..... | 2,446 | 13,852 | 4,248 | 29,374 | 2,346 | 17,935 | 1,557 | 9,405 | 352 | 3,399 |
| King..... | 1,007 | 8,058 | 964 | 10,684 | 660 | 6,813 | 441 | 3,798 | 11,931 | 104,649 |
| Red..... | 13,060 | 97,092 | 15,197 | 145,142 | 30,517 | 262,274 | 26,508 | 167,298 | | |
| Total..... | 17,283 | 126,194 | 22,307 | 203,127 | 34,337 | 263,377 | 28,859 | 183,176 | 12,773 | 111,550 |
| Bellies: | | | | | | | | | | |
| Coho..... | | | 191 | 2,696 | 229 | 3,535 | 255 | 3,843 | 126 | 1,135 |
| Chum..... | 30 | 150 | | | 117 | 699 | | | 70 | 770 |
| Humpback..... | 1,273 | 13,188 | 1,800 | 21,080 | 2,447 | 28,140 | 738 | 7,438 | 616 | 6,135 |
| King..... | 22 | 185 | 84 | 1,002 | 48 | 720 | 35 | 175 | 6 | 128 |
| Red..... | 13 | 121 | 890 | 12,644 | 1,895 | 26,236 | 942 | 13,902 | 808 | 10,839 |
| Total..... | 1,338 | 13,644 | 2,965 | 37,422 | 4,736 | 59,330 | 1,970 | 25,358 | 1,626 | 19,007 |
| Backs, etc.: | | | | | | | | | | |
| Humpback..... | | | | | | | 56 | 224 | | |
| King..... | | | | | | | | | 2 | 24 |
| Red..... | | | | | | | | | 4 | 60 |
| Total..... | | | | | | | 56 | 224 | 6 | 84 |
| Grand total... | 18,621 | 139,838 | 25,272 | 240,549 | 39,073 | 352,707 | 30,885 | 208,758 | 14,405 | 130,641 |

| Species. | 1911 | | 1912 | | 1913 | | 1914 | |
|----------------|----------|---------|----------|---------|----------|---------|----------|---------|
| | Barrels. | Value. | Barrels. | Value. | Barrels. | Value. | Barrels. | Value. |
| Whole salmon: | | | | | | | | |
| Coho..... | 223 | \$2,149 | 1,165 | \$9,565 | 1,006 | \$6,452 | 365 | \$2,767 |
| Chum..... | 133 | 666 | 93 | 652 | 100 | 778 | 53 | 293 |
| Humpback..... | 1,122 | 11,238 | 4,236 | 28,304 | 2,724 | 18,181 | 482 | 2,954 |
| King..... | 600 | 8,095 | 225 | 2,442 | 135 | 1,410 | 269 | 2,588 |
| Red..... | 6,239 | 79,578 | 28,883 | 204,965 | 33,916 | 245,905 | 24,785 | 238,593 |
| Total..... | 8,317 | 101,726 | 34,602 | 305,928 | 37,881 | 272,726 | 25,954 | 247,195 |
| Bellies: | | | | | | | | |
| Coho..... | 38 | 489 | | | 54 | 946 | 67 | 982 |
| Chum..... | 7 | 77 | | | 67 | 941 | 18 | 180 |
| Humpback..... | 676 | 5,122 | 37 | 606 | 324 | 4,546 | 229 | 2,620 |
| King..... | 2 | 30 | | | | | 2 | 13 |
| Red..... | 614 | 9,843 | | | 6 | 90 | 92 | 1,672 |
| Total..... | 1,337 | 15,561 | 37 | 606 | 451 | 6,523 | 408 | 5,467 |
| Backs, etc.: | | | | | | | | |
| Humpback..... | 150 | 600 | | | | | | |
| King..... | 1 | 15 | | | | | | |
| Red..... | 15 | 196 | | | | | | |
| Total..... | 166 | 751 | | | | | | |
| Grand total... | 9,820 | 118,038 | 34,639 | 306,534 | 38,332 | 279,249 | 26,362 | 252,662 |

^a Barrels hold 200 pounds of fish, when of a different size they have been reduced to conform to this weight.

ALASKA PICKLED-SALMON PACK, 1906 TO 1918, BY SPECIES, QUANTITY, AND VALUE—
Continued.

| Species. | 1915 | | 1916 | | 1917 | | 1918 | |
|-----------------------|----------|----------|----------|----------|----------|----------|----------|-----------|
| | Barrels. | Value. | Barrels. | Value. | Barrels. | Value. | Barrels. | Value. |
| Whole salmon: | | | | | | | | |
| Coho..... | 1,763 | \$19,393 | 2,076 | \$22,287 | 1,798 | \$29,631 | 2,501 | \$47,152 |
| Chum..... | 325 | 2,925 | 495 | 4,057 | 1,722 | 21,899 | 6,080 | 84,878 |
| Humpback..... | 662 | 5,958 | 503 | 3,624 | 5,576 | 73,857 | 11,973 | 182,490 |
| King..... | 377 | 4,147 | 636 | 7,956 | 3,359 | 6,556 | 7,297 | 7,645 |
| Red..... | 8,981 | 125,034 | 13,549 | 167,782 | 26,710 | 453,019 | 35,977 | 756,191 |
| Total..... | 12,058 | 157,457 | 17,259 | 205,706 | 36,165 | 584,962 | 56,828 | 1,078,356 |
| Bellies: | | | | | | | | |
| Coho..... | | | 27 | 500 | 11 | 326 | 10 | 180 |
| Chum..... | | | 285 | 3,556 | 73 | 1,362 | | |
| Humpback..... | 133 | 2,660 | 61 | 882 | 110 | 2,885 | 26 | 650 |
| King..... | | | 2 | 23 | 7 | 150 | | |
| Red..... | 438 | 10,950 | 100 | 2,000 | 24 | 812 | 17 | 595 |
| Total..... | 571 | 13,610 | 475 | 6,961 | 225 | 5,535 | 53 | 1,425 |
| Backs, etc: Coho..... | | | | | | | 9 | 100 |
| Grand total.... | 12,629 | 171,067 | 17,734 | 212,667 | 36,390 | 590,497 | 56,890 | 1,079,881 |

PACK OF SALTED SALMON IN ALASKA IN 1919.^a

| Products. ^b | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|------------------------|-------------------|----------|-----------------|---------|-----------------|---------|----------|----------|
| | Barrels. | Value. | Barrels. | Value. | Barrels. | Value. | Barrels. | Value. |
| Coho, or silver..... | 706 | \$13,206 | 204 | \$3,024 | 292 | \$5,918 | 1,202 | \$22,148 |
| Chum, or keta..... | 70 | 2,080 | 27 | 135 | 41 | 555 | 138 | 2,770 |
| Humpback, or pink..... | 26 | 260 | 50 | 700 | 45 | 548 | 121 | 1,508 |
| King, or spring..... | 241 | 4,542 | 8 | 232 | 618 | 16,267 | 867 | 21,041 |
| Red, or sockeye..... | 12 | 355 | 587 | 12,380 | 5,183 | 135,245 | 5,782 | 147,980 |
| Total..... | 1,055 | 20,443 | 876 | 16,471 | 6,179 | 158,533 | 8,110 | 195,447 |

^a From "Alaska Fisheries and Fur Industries in 1919," p. 50. By Ward T. Bower. Appendix IX, Report, U. S. Commissioner of Fisheries, 1919. Washington, 1920.

^b Each barrel holds 200 pounds of fish.

MILD-CURING INDUSTRY.

The beginning of this industry on the Pacific coast is of comparatively recent date, and the following table is complete, with the possible exception of a few tierces, which may not have been reported for the coastal rivers of Oregon:

TIERCES OF MILD-CURED SALMON PACKED ON PACIFIC COAST FROM 1897 TO 1919.^a

| Year. | Alaska. | British Columbia. | Puget Sound, Wash. | Grays Harbor, Wash. | Willapa Harbor, Wash. | Columbia River (both sides). | Coastal rivers, Oreg. | Eel River, Calif. | Sacramento River, Calif. | Monterey Bay, Calif. | Total. |
|------------|---------|-------------------|--------------------|---------------------|-----------------------|------------------------------|-----------------------|-------------------|--------------------------|----------------------|---------|
| 1897..... | | | | | | 400 | | | | | 400 |
| 1898..... | 70 | | | | | 700 | | | | | 770 |
| 1899..... | 130 | | | 375 | | 1,250 | | | | | 1,755 |
| 1900..... | | | | | | 1,275 | | | 950 | | 2,225 |
| 1901..... | 67 | | 600 | | | 3,000 | | | 3,100 | | 6,767 |
| 1902..... | 67 | | 425 | | | 4,213 | 188 | | 2,325 | 504 | 7,722 |
| 1903..... | 8 | | 821 | | | 6,725 | | | 3,600 | 354 | 11,511 |
| 1904..... | 34 | | 1,250 | | | 9,088 | | 200 | 4,719 | 248 | 15,539 |
| 1905..... | 189 | 1,175 | 3,000 | | | 9,805 | 415 | | 2,979 | 310 | 17,873 |
| 1906..... | 1,126 | 957 | | | | 8,000 | 740 | 175 | 2,177 | 510 | 13,685 |
| 1907..... | 1,657 | 1,993 | 2,060 | 20 | 100 | 6,070 | 740 | 140 | 4,102 | 582 | 17,464 |
| 1908..... | 1,378 | 1,060 | | | | 4,960 | | | 3,243 | 252 | 10,893 |
| 1909..... | 2,292 | 1,560 | 2,109 | 75 | 29 | 5,540 | 580 | 80 | 5,111 | 911 | 18,267 |
| 1910..... | 3,357 | 1,638 | 2,435 | 67 | | 7,922 | 1,398 | | 5,516 | 75 | 22,408 |
| 1911..... | 3,164 | 1,965 | 2,745 | 100 | 30 | 8,185 | 1,247 | 110 | 2,011 | 160 | 19,717 |
| 1912..... | 5,245 | 1,459 | 3,013 | 357 | 40 | 5,524 | 3,082 | 100 | 3,274 | | 22,424 |
| 1913..... | 7,443 | 3,150 | 3,923 | 250 | 50 | 5,746 | 2,381 | | 4,789 | 550 | 28,282 |
| 1914..... | 4,091 | 3,182 | 1,934 | | | 5,205 | 457 | | 1,829 | 1,476 | 18,174 |
| 1915..... | 2,966 | 1,119 | 2,235 | | | 4,078 | 333 | 3 | 1,630 | 942 | 13,306 |
| 1916..... | 4,898 | 1,848 | 1,755 | | | 4,656 | 194 | | 650 | 1,069 | 15,070 |
| 1917..... | 3,563 | 429 | 1,063 | | | 1,886 | | | 1,508 | 300 | 8,749 |
| 1918..... | 3,948 | 729 | 1,093 | | | 1,804 | 275 | 455 | 1,913 | 266 | 10,483 |
| 1919..... | 5,376 | 1,173 | 2,423 | | | 3,328 | 148 | b 1,326 | 2,355 | 1,055 | 17,184 |
| Total..... | 51,060 | 23,467 | 32,887 | 1,244 | 249 | 109,660 | 12,158 | 2,589 | 57,781 | 9,564 | 300,668 |

^a The net weight of fish in a tierce is about 800 pounds. King, chinook, or spring salmon were used almost exclusively. From most places the data are complete from the time of the inception of the industry, but from a few minor places the data are somewhat fragmentary.

^b Includes Fort Bragg, on Noyo River.

YUKON TERRITORY, CANADA.

Some salmon fishing is carried on in that section of the upper Yukon River which lies in Yukon Territory, Dominion of Canada. The species taken are principally king and dog, and these are sold mainly in a fresh condition. The following table shows the quantity taken and the value of same in certain years:

CATCH OF SALMON IN YUKON TERRITORY, CANADA, IN SPECIFIED YEARS.

| Year. | Salmon. | | Year. | Salmon. | |
|-----------|---------|---------|-----------|---------|----------|
| | Pounds. | Value. | | Pounds. | Value. |
| 1903..... | 70,000 | \$5,000 | 1914..... | 188,000 | \$18,800 |
| 1904..... | 158,574 | 17,506 | 1915..... | 157,000 | 15,700 |
| 1910..... | 160,900 | 18,689 | 1916..... | 143,500 | 14,350 |
| 1911..... | 225,000 | 22,900 | 1917..... | | |
| 1912..... | 224,100 | 22,410 | 1918..... | | |
| 1913..... | 182,000 | 18,200 | 1919..... | | |

TRADE WITH OUTLYING POSSESSIONS.

As a result of the war with Spain the United States in 1898 acquired possession of Porto Rico, Guam, and the Philippine Islands, while in the same year Hawaii became a part of this country at its own request, and in 1900 two islands of the Samoan group were acquired by a partition agreement with Great Britain and Germany. The trade with the Philippine Islands is shown to date in the tables

of exports and imports to foreign countries, but the trade with the other possessions has been eliminated from these tables and shown separately ever since their annexation to the United States.

HAWAII.

The islands constituting this Territory, owing to their reciprocity treaty with this country for a number of years before annexation, purchased their supplies of salmon from the United States almost exclusively. In recent years the Territory has imported the following quantities of salmon from the mainland:

| Year ending June 30— | Canned salmon. | | All other salmon, fresh or cured. | Year ending June 30— | Canned salmon. | | All other salmon, fresh or cured. |
|-------------------------|----------------|----------|--|-------------------------|----------------|----------|--|
| | Pounds. | Value. | | | Pounds. | Value. | |
| 1907..... | 1,126,217 | \$89,286 | Value. \$64,232 | 1914..... | 1,418,941 | \$97,532 | Value. (a) |
| 1908..... | 965,029 | 89,025 | 67,143 | 1915..... | 1,005,848 | 90,705 | (a) |
| 1909..... | 1,440,410 | 121,716 | 73,848 | 1916..... | 1,582,528 | 132,597 | (a) |
| 1910..... | 1,381,398 | 113,526 | 72,194 | 1917..... | 1,463,729 | 145,531 | (a) |
| 1911..... | 1,231,264 | 119,572 | 76,572 | 1918..... | 1,168,528 | 174,777 | (a) |
| 1912..... | 1,850,567 | 194,385 | 57,495 | 1919..... | 979,895 | 159,577 | (a) |
| 1913..... | 1,841,874 | 173,202 | (a) | | | | |

^a Not shown separately.

PORTO RICO.

Of recent years the following shipments of domestic salmon have been made to this island:

| Year ending June 30— | Canned salmon. | | All other salmon, fresh or cured. | Year ending June 30— | Canned salmon. | | All other salmon, fresh or cured. |
|-------------------------|----------------|----------|--|-------------------------|----------------|----------|--|
| | Pounds. | Value. | | | Pounds. | Value. | |
| 1907..... | 604,627 | \$53,916 | Value. \$2,893 | 1914..... | 416,414 | \$41,726 | Value. (a) |
| 1908..... | 512,035 | 48,195 | 1,428 | 1915..... | 588,889 | 56,527 | (a) |
| 1909..... | 381,171 | 34,777 | 3,810 | 1916..... | 860,873 | 60,453 | (a) |
| 1910..... | 511,055 | 43,494 | 6,243 | 1917..... | 881,300 | 70,427 | (a) |
| 1911..... | 357,382 | 30,699 | 3,868 | 1918..... | 378,266 | 52,737 | (a) |
| 1912..... | 710,721 | 65,354 | 1,208 | 1919..... | 468,501 | 68,532 | (a) |
| 1913..... | 666,602 | 66,811 | (a) | | | | |

^a Not shown separately.

PHILIPPINE ISLANDS.

Of recent years the following shipments of domestic salmon have been made to these islands:

| Year ending June 30— | Canned salmon. | | All other salmon, fresh or cured. | Year ending June 30— | Canned salmon. | | All other salmon, fresh or cured. |
|-------------------------|----------------|----------|--|-------------------------|----------------|-----------|--|
| | Pounds. | Value. | | | Pounds. | Value. | |
| 1909..... | 1,126,470 | \$74,792 | Value. \$712 | 1915..... | 4,159,580 | \$288,548 | Value. (a) |
| 1910..... | 5,425,404 | 396,604 | 2,089 | 1916..... | 5,640,858 | 356,366 | (a) |
| 1911..... | 3,069,118 | 225,885 | 3,542 | 1917..... | 4,202,574 | 351,633 | (a) |
| 1912..... | 5,096,810 | 422,001 | 2,437 | 1918..... | 5,558,796 | 618,697 | (a) |
| 1913..... | 10,122,820 | 590,128 | (a) | 1919..... | 3,880,425 | 431,616 | (a) |
| 1914..... | 5,034,252 | 266,369 | (a) | | | | |

^a Not shown separately.

ALASKA.

It seems like "carrying coals to Newcastle" to ship canned salmon to Alaska, from which Territory more than half the canned salmon of the world is produced, and yet a small business is done each year in this line, most of the product going to the mining camps and towns somewhat removed from the fishing sections.

The table below shows the shipments of such fish in recent years. After 1914 the shipments were lumped together with all other kinds of fish and thus prevented the listing of salmon separately.

| Year ending June 30— | Canned salmon. | | All other salmon, fresh or cured. | Year ending June 30— | Canned salmon. | | All other salmon, fresh or cured. |
|-------------------------|----------------|---------|--|-------------------------|----------------|----------|--|
| | Pounds. | Value. | | | Pounds. | Value. | |
| 1909..... | 67,132 | \$7,123 | Value. \$3,966 | 1912..... | 134,320 | \$15,022 | Value. \$4,218 |
| 1910..... | 67,658 | 7,204 | 3,558 | 1913..... | 43,346 | 5,074 | (a) |
| 1911..... | 38,265 | 4,513 | 1,061 | 1914..... | 42,945 | 5,278 | (a) |

a Not shown separately.

GUAM.

Since annexation, this country and Japan have been competing for the trade of this island, which, in earlier years, Japan controlled quite largely. During the last two years shown in the statement, however, the United States has secured the advantage. The table below shows the extent of the trade, which is made up almost entirely of salted or pickled salmon, only 900 pounds of fresh salmon, valued at \$92, having been shipped by this country to Guam in 1908. Since 1909 all the fishery products imported have been lumped under one heading and it has been impossible to distinguish the salmon from the other species.

| Year and country. | Pickled salmon. | | Year and country. | Pickled salmon. | |
|--------------------|-----------------|--------|--------------------|-----------------|--------|
| | Pounds. | Value. | | Pounds. | Value. |
| 1905. | | | 1908. | | |
| United States..... | 1,415 | \$71 | United States..... | 7,406 | \$623 |
| Japan..... | 16,526 | 1,221 | Japan..... | 6,130 | 465 |
| 1907. | | | 1909. | | |
| United States..... | 13,604 | 1,086 | United States..... | 10,779 | 740 |
| Japan..... | 19,862 | 1,601 | Japan..... | 4,295 | 344 |

TUTUILA, SAMOA.

The customs statistics lump the imports of fish under one general heading, thus making it impossible to show separately the imports of salmon.

FOREIGN TRADE IN SALMON.

As we do not consume all of the salmon produced by our fisheries, it is necessary to find a foreign market for the surplus each season, but, as canned salmon has become one of the staples of the world, there

is not much difficulty in this respect, especially since our only competitors are Canada, Siberia, and Japan. The two last named have not yet become important factors in the canned-salmon market, though they will as their fishing operations are extended. There is more competition in the pickled, fresh, and frozen markets, several European and Asiatic countries being large producers of these goods, as is Canada also, for a considerable proportion of which she is compelled to find an outside market.

The World War greatly disturbed the usual course of our foreign trade. Because of the need for foodstuffs a tremendous demand arose in Europe for our salmon, resulting in a decided increase in the quantities shipped there and, for a while, in a reduction of our exports in other directions. In time, however, the markets adjusted themselves to the changed conditions of trade.

EXPORTS OF DOMESTIC CANNED SALMON.

From the beginning of the industry a considerable proportion of the salmon canned has been exported, especially of the higher grades. In Europe the chief customer is Great Britain, followed closely in the closing years of the war by Italy. Great Britain does not, however, consume this quantity, for a considerable part of her importations are reexported. On the North American Continent and adjacent islands the best customers are Mexico, Cuba, Panama, and the British West Indies, in the order named. The heavy shipments to Canada since 1916 are mainly in transit shipments to Europe by Canadian steamship lines as our lines were overburdened with war shipments. In South America, Chile, Peru, Argentina, and Ecuador were the leading markets in 1918. In Asia, Hongkong and China import canned salmon, although neither buys great quantities. The islands of the Pacific and Indian Oceans are large consumers. British Australasia took 7,811,387 pounds, valued at \$1,407,561 in 1918, and other good customers were the British East Indies and British, French, and German Oceania. In Africa the British and Portuguese possessions are the largest importers.

The movements of these products are naturally often influenced favorably or adversely as the tariffs of the various countries in which they are marketed are raised or lowered.

Some countries maintain excessively high tariffs, among these being Brazil, 30 cents per pound; Colombia, 8½ cents; Mexico, 4 cents; Guatemala, 6½ cents; Paraguay, 7 cents; Uruguay, 6 cents; Austria-Hungary, 8 cents, and Germany, 7 cents. Norway levies 6 cents a pound duty, but this is undoubtedly to protect her own salmon industry.

In but few of the tariff acts is canned salmon distinguished by name, being usually classed as "preserved fish," and as these are usually luxuries in many countries they bear an extra high duty as a result.

In addition to these high duties in some countries, especially in South America, there are various other charges, fees, etc., which materially enhance the value of the goods before they reach the consumer. C. H. Clarke, of the salmon brokerage firm of Kelley-Clarke Co., of Seattle, Wash., prepared and published a statement ^a

^a Pacific Fisherman, Vol. 13, No. 5, p. 11, 1915.

showing the comparative charges on 100 cases each of red Alaska and pink canned salmon from the time they leave Seattle up to the time they reach the hands of wholesalers in South America. This shows that the f. o. b. Seattle value of the red salmon was \$500 and of the pink salmon \$280. By the time these goods reached the hands of the Rio de Janeiro wholesalers the red salmon were worth \$1,900.07, while the pink salmon were worth \$1,677.87. At Montevideo, Uruguay, the red salmon were worth \$1,436.01 and the pink salmon \$1,213.81. The table is so interesting and instructive that it is reproduced entire herewith.

COMPARATIVE CHARGES ON 100 CASES EACH OF RED ALASKA AND PINK CANNED SALMON FROM SEATTLE, WASH., TO HANDS OF WHOLESALEERS IN SOUTH AMERICA.

| | Argentina (Buenos Aires). | | Brazil (Rio de Janeiro). | | Chile (Valparaiso). | | Ecuador (Guayaquil) | |
|--|------------------------------|----------|-----------------------------|----------|------------------------|----------|------------------------|----------|
| | Red. | Pink. | Red. | Pink. | Red. | Pink. | Red. | Pink. |
| F. o. b. Seattle value..... | \$500.00 | \$280.00 | \$500.00 | \$280.00 | \$500.00 | \$280.00 | \$500.00 | \$280.00 |
| Strapping..... | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| Freight..... | 164.75 | 164.75 | 114.50 | 114.50 | 45.00 | 45.00 | 45.00 | 45.00 |
| Marine insurance, 5 per cent f. p. a..... | 6.10 | 3.90 | 6.20 | 4.00 | 5.50 | 3.25 | 5.50 | 3.25 |
| C. i. f. value..... | 615.85 | 393.65 | 625.70 | 403.50 | 550.50 | 328.25 | 550.50 | 328.25 |
| Consular fees in United States..... | 2.00 | 2.00 | 3.25 | 3.25 | 5.25 | 4.25 | 22.35 | 14.00 |
| Customs duty..... | 519.56 | 519.56 | 1,138.78 | 1,138.78 | 160.46 | 160.46 | 345.37 | 234.37 |
| Analysis..... | 2.12 | 2.12 | 6.47 | 6.47 | ..... | ..... | ..... | ..... |
| Storage in customhouse..... | 2.41 | 2.41 | 33.90 | 33.90 | 5.35 | 5.35 | ..... | ..... |
| Handling in customhouse..... | 7.24 | 7.24 | ..... | ..... | 2.51 | 2.51 | ..... | ..... |
| Stamps and entry blanks..... | 1.49 | 1.49 | ..... | ..... | 1.43 | 1.43 | ..... | ..... |
| Statistics..... | ..... | ..... | .10 | .10 | ..... | ..... | ..... | ..... |
| Internal-revenue tax..... | ..... | ..... | 7.77 | 7.77 | ..... | ..... | ..... | ..... |
| Port tax..... | ..... | ..... | 57.20 | 57.20 | ..... | ..... | ..... | ..... |
| Customs brokerage..... | 12.74 | 12.74 | ..... | ..... | 7.15 | 7.15 | ..... | ..... |
| Wharfage, lighterage, cartage..... | 7.61 | 7.61 | 26.90 | 26.90 | 3.65 | 3.65 | 19.30 | 19.30 |
| Value ex customhouse..... | 1,171.05 | 948.85 | 1,900.07 | 1,677.87 | 736.30 | 513.05 | 937.52 | 706.92 |

| | Paraguay (Asunción). | | Peru (Callao). | | Uruguay (Montevideo). | | Venezuela (La Guayra). | |
|--|-------------------------|----------|-------------------|----------|--------------------------|----------|---------------------------|----------|
| | Red. | Pink. | Red. | Pink. | Red. | Pink. | Red. | Pink. |
| F. o. b. Seattle value..... | \$500.00 | \$280.00 | \$500.00 | \$280.00 | \$500.00 | \$280.00 | \$500.00 | \$280.00 |
| Strapping..... | 5.00 | 5.00 | ..... | ..... | 5.00 | 5.00 | 5.00 | 5.00 |
| Freight..... | 134.75 | 134.75 | 37.50 | 37.50 | 104.75 | 104.75 | 54.60 | 54.60 |
| Marine insurance, 5 per cent f. p. a..... | 9.60 | 6.30 | 5.40 | 3.20 | 6.10 | 3.90 | 5.60 | 3.40 |
| C. i. f. value..... | 649.35 | 426.05 | 542.90 | 320.70 | 615.85 | 393.65 | 565.20 | 343.00 |
| Consular fees in United States..... | 2.00 | 2.00 | 5.75 | 3.45 | 1.05 | 1.05 | 12.85 | 12.85 |
| Customs duty..... | 308.25 | 308.25 | 275.86 | 275.86 | 779.30 | 779.30 | 238.96 | 238.06 |
| Analysis..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Storage in customhouse..... | ..... | ..... | ..... | ..... | 16.15 | 16.15 | ..... | ..... |
| Handling in customhouse..... | ..... | ..... | ..... | ..... | 16.15 | 16.15 | ..... | ..... |
| Stamps and entry blanks..... | ..... | ..... | .58 | .58 | 1.55 | 1.55 | 1.35 | .97 |
| Statistics..... | .37 | .37 | ..... | ..... | ..... | ..... | ..... | ..... |
| Internal-revenue tax..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Port tax..... | ..... | ..... | 4.86 | 4.86 | 15.50 | 15.50 | 5.00 | 2.80 |
| Customs brokerage..... | ..... | ..... | 15.69 | 15.69 | 6.61 | 6.61 | 12.82 | 12.82 |
| Wharfage, lighterage, cartage..... | 6.33 | 6.33 | 15.69 | 15.69 | 6.61 | 6.61 | 12.82 | 12.82 |
| Value ex customhouse..... | 966.30 | 743.00 | 845.61 | 621.11 | 1,436.01 | 1,213.81 | 836.18 | 611.40 |

The following table shows in summarized form the yearly exports of domestic canned salmon and the countries to which exported for the years 1900 to 1915, inclusive, and in detailed form for the years 1916 to 1918, inclusive:

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC CANNED SALMON.

SUMMARY, 1900-1915.^a

| Country receiving. | 1900 | | 1901 | | 1902 | | 1903 | |
|--------------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Europe..... | 18,941,109 | \$1,881,725 | 31,877,663 | \$3,234,862 | 30,683,551 | \$2,625,281 | 35,410,768 | \$3,125,197 |
| North America..... | 1,051,808 | 98,064 | 2,443,561 | 297,440 | 2,780,844 | 242,029 | 4,285,406 | 378,655 |
| South America..... | 1,868,225 | 192,918 | 1,577,013 | 160,862 | 1,291,998 | 107,907 | 1,756,214 | 121,918 |
| Asia..... | 654,126 | 67,941 | 853,434 | 86,571 | 1,597,346 | 120,674 | 1,759,294 | 134,783 |
| Oceania..... | 3,882,646 | 390,466 | 3,681,276 | 367,533 | 8,179,161 | 670,741 | 5,511,514 | 444,505 |
| Africa..... | 684,456 | 62,534 | 856,553 | 83,003 | 2,640,214 | 224,767 | 1,630,138 | 145,733 |

| Country receiving. | 1904 | | 1905 | | 1906 | |
|--------------------|------------|-------------|------------|-------------|------------|-------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Europe..... | 33,591,896 | \$3,508,818 | 21,071,263 | \$1,877,509 | 32,061,402 | \$2,753,643 |
| North America..... | 2,446,023 | 204,363 | 1,565,773 | 132,134 | 2,069,357 | 171,946 |
| South America..... | 2,055,859 | 147,333 | 1,708,828 | 134,941 | 3,499,603 | 249,052 |
| Asia..... | 12,995,768 | 930,054 | 3,994,862 | 280,704 | 779,415 | 60,173 |
| Oceania..... | 3,898,606 | 341,849 | 5,257,446 | 467,928 | 6,340,346 | 509,257 |
| Africa..... | 936,126 | 92,181 | 1,468,383 | 142,253 | 1,194,291 | 103,872 |

| Country receiving. | 1907 | | 1908 | | 1909 | |
|--------------------|-----------|-----------|------------|-------------|------------|-------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Europe..... | 7,756,780 | \$791,436 | 13,321,086 | \$1,205,375 | 23,028,476 | \$2,207,194 |
| North America..... | 3,052,658 | 261,138 | 2,654,175 | 242,879 | 2,209,405 | 198,043 |
| South America..... | 5,659,690 | 414,774 | 5,571,000 | 410,743 | 1,461,662 | 123,502 |
| Asia..... | 1,419,391 | 105,364 | 1,004,571 | 86,908 | 1,386,702 | 119,582 |
| Oceania..... | 6,719,157 | 552,205 | 5,131,554 | 439,917 | 7,383,494 | 705,204 |
| Africa..... | 610,429 | 58,132 | 543,659 | 52,696 | 647,370 | 62,911 |

| Country receiving. | 1910 | | 1911 | | 1912 | |
|--------------------|------------|-------------|------------|-------------|------------|-------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Europe..... | 44,765,898 | \$4,712,182 | 22,134,328 | \$2,408,708 | 19,545,720 | \$2,183,982 |
| North America..... | 2,221,516 | 191,551 | 1,979,950 | 190,637 | 3,411,176 | 332,692 |
| South America..... | 3,193,812 | 226,197 | 3,006,927 | 266,903 | 6,756,440 | 609,383 |
| Asia..... | 1,596,775 | 133,516 | 1,489,282 | 148,721 | 1,702,426 | 160,119 |
| Oceania..... | 11,568,824 | 998,219 | 9,699,624 | 991,540 | 11,220,515 | 1,255,149 |
| Africa..... | 510,871 | 52,593 | 290,688 | 30,633 | 787,479 | 79,238 |

| Country receiving. | 1913 | | 1914 | | 1915 | |
|--------------------|------------|-------------|------------|-------------|------------|-------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Europe..... | 25,408,154 | \$2,705,254 | 62,862,328 | \$6,026,170 | 63,760,758 | \$7,110,728 |
| North America..... | 4,271,710 | 370,823 | 6,907,615 | 511,545 | 4,328,246 | 370,444 |
| South America..... | 4,134,771 | 292,367 | 3,472,438 | 233,675 | 1,301,962 | 107,783 |
| Asia..... | 3,593,538 | 254,209 | 2,875,995 | 180,402 | 1,135,793 | 97,662 |
| Oceania..... | 17,419,390 | 1,441,270 | 12,089,003 | 1,017,994 | 12,100,414 | 1,309,376 |
| Africa..... | 463,403 | 39,417 | 353,541 | 29,507 | 818,943 | 76,450 |

^a Detailed statistics for 1900 to 1915, inclusive, may be found in "Pacific Salmon Fisheries," by John N. Cobb, Appendix III, Report, U. S. Commissioner of Fisheries, 1916, pp. 187-194. Washington, 1917.

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC CANNED SALMON—Continued.

DETAILS, 1916 TO 1918.*

| Country receiving. | 1916 | | 1917 | | 1918 | |
|---------------------------------|-------------|------------|------------|-----------|------------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| EUROPE. | | | | | | |
| Belgium..... | | | 1,115,792 | \$8,546 | 18,000 | \$2,525 |
| Denmark..... | 366,948 | \$29,255 | 89,405 | 9,650 | | |
| France..... | 3,447,022 | 377,597 | 985,582 | 153,927 | 7,937,490 | 1,167,737 |
| Gibraltar..... | | | | | 1,156,864 | 167,157 |
| Greece..... | 70,560 | 6,059 | 190,736 | 14,486 | 173,400 | 24,935 |
| Iceland, and Faroe Islands..... | 136 | 16 | 2,820 | 297 | 96 | 16 |
| Italy..... | 34,184 | 3,170 | 4,169,250 | 436,576 | 13,540,046 | 1,752,163 |
| Malta, Gozo, etc..... | 9,120 | 702 | 5,520 | 525 | | |
| Netherlands..... | 21,868 | 2,865 | 20,450 | 2,709 | | |
| Norway..... | 41,280 | 4,383 | 54,440 | 6,164 | | |
| Portugal..... | 20 | 2 | 60 | 7 | 794 | 178 |
| Russia in Europe..... | | | 240 | 18 | | |
| Serbia and Monten. gro..... | 170 | 17 | | | | |
| Spain..... | 4,995 | 382 | 37,481 | 3,300 | 1,315 | 274 |
| Sweden..... | 60,122 | 6,666 | 14,100 | 1,800 | | |
| United Kingdom: | | | | | | |
| England..... | 109,039,707 | 11,105,506 | 74,941,169 | 8,536,248 | 46,415,026 | 7,447,389 |
| Scotland..... | 1,067,590 | 111,381 | 1,131,832 | 139,718 | 848,295 | 129,652 |
| Ireland..... | | | | | 900 | 220 |
| NORTH AMERICA. | | | | | | |
| Bermuda..... | 89,599 | 8,741 | 193,523 | 22,066 | 87,832 | 16,028 |
| British Honduras..... | 32,021 | 3,228 | 30,057 | 3,072 | 25,178 | 3,410 |
| Canada..... | 7,994,185 | 677,655 | 9,158,079 | 838,734 | 12,184,077 | 1,755,690 |
| Central American States: | | | | | | |
| Costa Rica..... | 118,002 | 8,878 | 95,435 | 8,065 | 10,750 | 1,643 |
| Guatemala..... | 58,528 | 4,084 | 45,484 | 4,708 | 19,026 | 2,584 |
| Honduras..... | 37,695 | 3,651 | 26,168 | 3,080 | 10,536 | 1,612 |
| Nicaragua..... | 36,644 | 3,064 | 50,719 | 6,029 | 33,421 | 5,115 |
| Panama..... | 638,045 | 57,042 | 454,064 | 50,793 | 306,765 | 49,031 |
| Salvador..... | 21,404 | 1,826 | 18,368 | 2,134 | 6,691 | 1,144 |
| Mexico..... | 1,611,929 | 132,406 | 3,707,225 | 342,561 | 1,800,185 | 246,830 |
| Miquelon, Langley, etc..... | 957 | 100 | 3,026 | 377 | 60 | 8 |
| Newfoundland and Labrador.. | 700 | 37 | 2,640 | 286 | | |
| West Indies: | | | | | | |
| British— | | | | | | |
| Barbados..... | 60,361 | 5,767 | 73,610 | 8,643 | 97,722 | 18,121 |
| Jamaica..... | 228,973 | 19,017 | 180,965 | 18,317 | 86,503 | 14,170 |
| Trinidad and Tobago.. | 267,548 | 26,060 | 134,832 | 18,230 | 372,420 | 61,443 |
| Other British..... | 78,578 | 7,097 | 109,094 | 12,001 | 32,116 | 5,760 |
| Cuba..... | 927,129 | 87,479 | 1,619,236 | 149,492 | 1,632,073 | 210,167 |
| Panama..... | 11,382 | 1,063 | 34,598 | 4,100 | 23,629 | 4,633 |
| Dutch..... | 21,399 | 2,122 | 24,673 | 2,782 | 8,370 | 1,683 |
| French..... | 4,772 | 477 | 4,770 | 543 | 548 | 80 |
| Haiti..... | 3,586 | 361 | 4,297 | 486 | 1,793 | 349 |
| Santo Domingo..... | 86,722 | 7,048 | 231,413 | 22,859 | 100,417 | 14,148 |
| SOUTH AMERICA. | | | | | | |
| Argentina..... | 273,900 | 23,429 | 191,618 | 19,043 | 353,103 | 61,428 |
| Bolivia..... | 14,579 | 1,466 | 122,092 | 11,724 | 211,978 | 24,478 |
| Brazil..... | 49,742 | 3,921 | 61,657 | 7,599 | 187,615 | 26,245 |
| Chile..... | 2,812,347 | 192,581 | 1,452,155 | 121,019 | 2,304,499 | 330,244 |
| Colombia..... | 149,254 | 11,514 | 126,861 | 22,575 | 75,477 | 11,479 |
| Ecuador..... | 246,149 | 16,009 | 276,654 | 25,302 | 215,456 | 28,360 |
| Guiana— | | | | | | |
| British..... | 184,654 | 18,249 | 196,261 | 26,637 | 151,719 | 27,749 |
| Dutch..... | 87,308 | 8,048 | 39,060 | 3,888 | 35,143 | 5,812 |
| French..... | 25,128 | 2,371 | 17,909 | 1,910 | 26,560 | 3,825 |
| Peru..... | 526,380 | 36,361 | 434,329 | 37,417 | 1,159,276 | 158,791 |
| Uruguay..... | 23,464 | 1,841 | 5,258 | 590 | 6,630 | 1,509 |
| Venezuela..... | 195,618 | 16,234 | 297,125 | 28,158 | 181,236 | 26,834 |
| ASIA. | | | | | | |
| Aden..... | 27,716 | 2,817 | | | 2,832 | 472 |
| China..... | | | 42,017 | 5,177 | 68,949 | 13,372 |
| China, leased territory: | | | | | | |
| Japanese..... | 96 | 16 | 192 | 32 | 144 | 30 |
| Chosen..... | 1,632 | 172 | 2,620 | 466 | 1,062 | 207 |

* From Pacific Fisherman Yearbook for 1919, p. 93. Customs returns are for the fiscal year ending June 30 of the year noted.

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC CANNED SALMON—Continued.

DETAILS, 1916 TO 1918—Continued.

| Country receiving. | 1916 | | 1917 | | 1918 | |
|---------------------------|-------------|------------|-------------|------------|-------------|------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| ASIA—continued. | | | | | | |
| East Indies: | | | | | | |
| British— | | | | | | |
| British India..... | 1,117,839 | \$91,767 | 601,935 | \$62,264 | 1,349,057 | \$222,947 |
| Straits Settlements... | 1,215,214 | 71,585 | 106,896 | 9,081 | 232,755 | 34,468 |
| Other British..... | 166,144 | 12,787 | 101,286 | 10,355 | 41,818 | 6,944 |
| Dutch..... | 727,005 | 81,121 | 374,832 | 42,693 | 405,326 | 66,240 |
| French..... | 4,712 | 615 | 6,816 | 1,340 | 240 | 69 |
| Hongkong..... | 47,558 | 5,170 | 74,585 | 9,570 | 86,203 | 14,678 |
| Japan..... | 1,348 | 141 | 2,604 | 310 | 4,590 | 883 |
| Persia..... | 24,960 | 1,892 | 9,600 | 800 | | |
| Russia in Asia..... | 48 | 4 | | | | |
| Siam..... | 1,392 | 219 | 2,880 | 533 | 6,048 | 1,012 |
| OCEANIA. | | | | | | |
| British: | | | | | | |
| Australia and Tasmania... | 11,035,294 | 1,204,354 | 6,990,835 | 865,865 | 7,397,009 | 1,337,231 |
| New Zealand..... | 216,292 | 24,684 | 96,912 | 10,332 | 240,240 | 45,409 |
| Other British..... | 30,878 | 2,923 | 141,735 | 14,749 | 174,138 | 24,921 |
| French..... | 290,854 | 29,201 | 248,415 | 32,643 | 186,574 | 31,160 |
| German..... | 448,860 | 29,434 | 357,386 | 37,172 | 285,605 | 39,071 |
| Philippine Islands..... | 5,640,858 | 356,366 | 4,202,574 | 351,633 | 5,558,796 | 618,697 |
| AFRICA. | | | | | | |
| British Africa: | | | | | | |
| West..... | 100,310 | 7,860 | 613,545 | 62,925 | 480,414 | 72,960 |
| South..... | 620,555 | 56,255 | 1,421,021 | 157,853 | 1,293,714 | 161,423 |
| East..... | | | 25,608 | 2,543 | 57,275 | 8,938 |
| Belgian Congo..... | | | 1,750 | 331 | 2,293 | 463 |
| Canary Islands..... | 10,480 | 1,071 | 7,200 | 432 | 836 | 115 |
| Egypt..... | 103,800 | 9,534 | | | 261,673 | 42,335 |
| French Africa..... | | | 2,250 | 235 | 20,268 | 4,255 |
| Italian Africa..... | 110 | 10 | | | | |
| Liberia..... | 3,624 | 366 | 2,810 | 258 | 9,448 | 1,499 |
| Portuguese Africa..... | 37,508 | 3,231 | 138,580 | 13,291 | 52,298 | 7,207 |
| Spanish Africa..... | 9,700 | 911 | 138,580 | 13,291 | 8,845 | 1,175 |
| Total..... | 152,943,962 | 15,032,497 | 117,962,807 | 12,963,425 | 110,060,480 | 16,570,834 |
| RECAPITULATION. | | | | | | |
| Europe..... | 114,163,722 | 11,648,003 | 82,758,877 | 9,390,858 | 70,092,226 | 10,692,246 |
| North America..... | 12,322,259 | 1,056,904 | 16,196,177 | 1,565,409 | 16,840,112 | 2,413,649 |
| South America..... | 4,563,993 | 332,024 | 3,314,969 | 305,964 | 4,899,692 | 706,757 |
| Asia..... | 3,336,665 | 268,306 | 1,326,163 | 142,641 | 2,199,024 | 361,322 |
| Oceania..... | 17,659,036 | 1,646,962 | 12,037,857 | 1,312,394 | 13,842,362 | 2,096,439 |
| Africa..... | 898,298 | 80,298 | 2,328,764 | 246,159 | 2,187,064 | 300,371 |

In 1918 the practice of publishing customs figures for the calendar year instead of the fiscal year, as had prevailed previously, was inaugurated. The following tables show the exports of canned salmon, by countries, for the calendar years 1918 and 1919:

EXPORTS, BY COUNTRIES RECEIVING, OF CANNED SALMON, CALENDAR YEARS 1918 AND 1919.

| Country receiving. | 1918 | | 1919 | |
|--------------------------------------|------------|-----------|------------|------------|
| | Pounds. | Value. | Pounds. | Value. |
| EUROPE. | | | | |
| Austria-Hungary..... | | | 157,396 | \$33,394 |
| Azores, and Madeira Islands..... | | | 432 | 71 |
| Belgium..... | 18,072 | \$2,539 | 5,179,022 | 970,696 |
| Denmark..... | | | 1,082,434 | 181,178 |
| Finland..... | | | 68,000 | 13,010 |
| France..... | 11,458,346 | 1,270,675 | 15,947,105 | 2,525,449 |
| Germany..... | | | 833,793 | 147,783 |
| Gibraltar..... | 273,540 | 44,593 | 370,890 | 85,860 |
| Greece..... | | | 2,722,686 | 471,555 |
| Iceland, and Faroe Islands..... | | | 12,025 | 2,557 |
| Italy..... | 19,654,988 | 2,785,844 | 36,925,190 | 4,801,911 |
| Malta, Gozo, etc..... | | | 1,892 | 262 |
| Netherlands..... | | | 231,710 | 46,356 |
| Norway..... | | | 441,776 | 87,668 |
| Portugal..... | 662 | 193 | 200 | 38 |
| Rumania..... | | | 9,720 | 1,538 |
| Russia in Europe..... | | | 19,500 | 2,795 |
| Serbia, Montenegro, and Albania..... | | | 480 | 96 |
| Spain..... | | | 79,457 | 16,253 |
| Sweden..... | 164 | 40 | 88,012 | 17,158 |
| Switzerland..... | | | 12,184 | 2,114 |
| Turkey in Europe..... | | | 100,010 | 17,072 |
| United Kingdom: | | | | |
| England..... | 43,515,880 | 6,742,494 | 66,524,438 | 12,788,932 |
| Scotland..... | 154,495 | 22,672 | 1,460,082 | 219,951 |
| Ireland..... | 1,320 | 286 | 1,459,360 | 197,677 |
| NORTH AMERICA. | | | | |
| Bermuda..... | 35,144 | 6,288 | 53,429 | 6,940 |
| British Honduras..... | 8,560 | 1,181 | 58,194 | 9,409 |
| Canada..... | 4,077,166 | 620,195 | 9,587,861 | 1,467,611 |
| Central American States: | | | | |
| Costa Rica..... | 5,310 | 818 | 98,155 | 16,049 |
| Guatemala..... | 10,492 | 1,374 | 74,407 | 12,599 |
| Honduras..... | 3,459 | 488 | 50,936 | 8,693 |
| Nicaragua..... | 11,586 | 1,866 | 125,179 | 21,095 |
| Panama..... | 172,296 | 30,485 | 141,733 | 25,141 |
| Salvador..... | 4,290 | 741 | 29,783 | 5,173 |
| Mexico..... | 347,384 | 54,709 | 4,917,900 | 705,362 |
| Miquelon, Langley, etc..... | | | 3,090 | 751 |
| Newfoundland and Labrador..... | | | 108 | 21 |
| West Indies: | | | | |
| British— | | | | |
| Barbados..... | 33,074 | 6,305 | 65,114 | 12,947 |
| Jamaica..... | 77,002 | 12,225 | 367,119 | 51,537 |
| Trinidad and Tobago..... | 153,207 | 24,923 | 143,691 | 27,023 |
| Other British..... | 10,148 | 1,983 | 37,935 | 7,717 |
| Cuba..... | 428,208 | 60,432 | 1,646,913 | 298,858 |
| Dominican Republic..... | 50,887 | 7,973 | 238,502 | 36,503 |
| Dutch..... | 3,206 | 701 | 17,678 | 4,603 |
| French..... | 184 | 24 | 10,456 | 2,422 |
| Haiti..... | 1,036 | 190 | 6,199 | 1,393 |
| Virgin Islands of United States..... | 20,059 | 4,221 | 22,498 | 4,447 |
| SOUTH AMERICA. | | | | |
| Argentina..... | 255,950 | 51,437 | 403,019 | 76,672 |
| Bolivia..... | 94,076 | 8,765 | 84,559 | 15,087 |
| Brazil..... | 161,529 | 21,625 | 31,113 | 7,273 |
| Chile..... | 1,316,148 | 195,478 | 1,331,484 | 214,284 |
| Colombia..... | 31,816 | 5,493 | 275,050 | 47,078 |
| Ecuador..... | 40,358 | 5,895 | 368,939 | 55,947 |
| Guiana: | | | | |
| British..... | 38,595 | 7,765 | 122,715 | 25,974 |
| Dutch..... | 13,769 | 2,380 | 68,581 | 14,336 |
| French..... | 5,456 | 778 | 36,562 | 7,007 |
| Paraguay..... | | | 240 | 55 |
| Peru..... | 290,337 | 41,262 | 1,180,989 | 185,839 |
| Uruguay..... | 6,240 | 1,441 | 47,412 | 9,932 |
| Venezuela..... | 129,457 | 19,907 | 383,120 | 63,321 |
| ASIA. | | | | |
| Aden..... | 2,400 | 394 | 2,880 | 480 |
| China..... | 41,980 | 8,570 | 90,232 | 19,088 |

EXPORTS, BY COUNTRIES RECEIVING, OF CANNED SALMON, CALENDAR YEARS 1918
AND 1919—Continued.

| Country receiving. | 1918 | | 1919 | |
|--|------------|------------|-------------|------------|
| | Pounds. | Value. | Pounds. | Value. |
| ASIA—continued. | | | | |
| China, leased territory: Japanese..... | 48 | \$10 | 168 | \$43 |
| Chosen..... | 42 | 8 | 5,274 | 1,246 |
| East Indies: | | | | |
| British— | | | | |
| British India..... | 367,273 | 67,256 | 984,672 | 193,089 |
| Straits Settlements..... | 111,440 | 16,021 | 223,168 | 42,403 |
| Other British..... | 26,890 | 4,495 | 61,814 | 13,402 |
| Dutch..... | 124,502 | 17,692 | 427,298 | 71,132 |
| French..... | 240 | 69 | 2,412 | 692 |
| Hongkong..... | 41,424 | 7,839 | 116,912 | 22,628 |
| Japan..... | 25,968 | 3,259 | 12,038 | 1,940 |
| Russia in Asia..... | | | 192 | 52 |
| Siam..... | 4,800 | 760 | 2,122 | 558 |
| Turkey in Asia..... | | | 20,504 | 3,646 |
| OCEANIA. | | | | |
| British: | | | | |
| Australia..... | 1,149,888 | 215,715 | 5,777,713 | 1,293,194 |
| New Zealand..... | 26,592 | 4,835 | 61,533 | 13,919 |
| Other British..... | 67,674 | 9,872 | 93,423 | 16,115 |
| French..... | 116,535 | 19,203 | 225,429 | 42,303 |
| German..... | 153,840 | 20,394 | 80,577 | 12,966 |
| Philippine Islands..... | 5,291,182 | 579,410 | 2,371,736 | 279,408 |
| AFRICA. | | | | |
| Abyssinia..... | | | 92 | 18 |
| Belgian Kongo..... | 2,354 | 477 | 14,990 | 3,251 |
| British Africa: | | | | |
| West..... | 192,376 | 33,051 | 976,463 | 172,258 |
| South..... | 121,990 | 18,255 | 1,269,317 | 284,633 |
| East..... | 34,260 | 6,098 | 5,996 | 1,417 |
| Canary Islands..... | | | 59,790 | 8,025 |
| Egypt..... | 261,673 | 42,335 | 939,895 | 133,358 |
| French Africa..... | 17,136 | 3,572 | 32,989 | 7,208 |
| German Africa..... | | | 50,465 | 9,332 |
| Liberia..... | 2,633 | 539 | 8,218 | 1,761 |
| Madagascar..... | | | 48 | 8 |
| Morocco..... | | | 5,688 | 932 |
| Portuguese Africa..... | 2,788 | 485 | 31,868 | 6,839 |
| Spanish Africa..... | | | 36,266 | 7,009 |
| Total..... | 91,101,734 | 13,149,307 | 169,750,672 | 28,644,706 |

The following table shows in summarized form the customs districts from which canned salmon was exported for the years 1900 to 1915, inclusive, and in detailed form for the years 1916 to 1919, inclusive. Up to 1910 about two-thirds of the total exports have gone from the port of San Francisco, while about one-fifth of the total passed through the port of Puget Sound, Wash. In 1910 the exports from Puget Sound exceeded those from San Francisco. In 1918, however, San Francisco assumed first place once more. The only other port through which any considerable quantity is shipped is New York City. It is usual now to load the salmon on steamers and sailing vessels at San Francisco and the Puget Sound cities to go direct to Europe.

EXPORTS, BY CUSTOMS DISTRICTS, OF CANNED SALMON.

SUMMARY, 1900 TO 1915.^a

| Customs district from which exported. | 1900 | | 1901 | | 1902 | | 1903 | |
|---------------------------------------|------------|-----------|------------|-----------|------------|-----------|------------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Atlantic ports..... | 3,820,656 | \$370,362 | 8,834,322 | \$947,729 | 4,538,073 | \$427,335 | 5,734,469 | \$611,868 |
| Gulf ports..... | 38,868 | 3,430 | 55,425 | 5,426 | 50,116 | 4,965 | 54,016 | 5,085 |
| Mexican border ports..... | 30,264 | 2,861 | 20,140 | 2,082 | 188,346 | 15,498 | 130,363 | 11,741 |
| Pacific ports..... | 23,168,445 | 2,314,541 | 32,337,112 | 3,270,524 | 42,357,217 | 3,539,231 | 44,391,379 | 3,716,926 |
| Northern border and Lake ports..... | 24,137 | 2,514 | 42,501 | 4,510 | 39,362 | 4,373 | 43,107 | 5,171 |
| | | | | | | | | |
| Customs district from which exported. | 1904 | | 1905 | | 1906 | | | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Atlantic ports..... | 2,133,121 | \$214,332 | 2,693,593 | \$267,263 | 3,277,571 | \$318,321 | | |
| Gulf ports..... | 72,792 | 6,455 | 97,561 | 8,425 | 127,255 | 10,910 | | |
| Mexican border ports..... | 365,248 | 24,183 | 289,439 | 23,148 | 155,413 | 36,130 | | |
| Pacific ports..... | 53,362,492 | 4,979,565 | 31,957,252 | 2,734,269 | 41,906,406 | 3,469,472 | | |
| Northern border and Lake ports..... | 625 | 63 | 28,800 | 2,364 | 177,769 | 13,110 | | |
| | | | | | | | | |
| Customs district from which exported. | 1907 | | 1908 | | 1909 | | | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Atlantic ports..... | 2,314,535 | \$227,779 | 2,334,663 | \$227,113 | 4,043,807 | \$469,933 | | |
| Gulf ports..... | 165,650 | 14,450 | 206,120 | 19,245 | 107,018 | 8,954 | | |
| Mexican border ports..... | 570,343 | 47,776 | 723,689 | 65,119 | 219,128 | 21,574 | | |
| Pacific ports..... | 22,160,349 | 1,892,398 | 24,961,173 | 2,126,995 | 31,705,144 | 2,971,981 | | |
| Northern border and Lake ports..... | 7,828 | 646 | 400 | 46 | 42,012 | 3,991 | | |
| | | | | | | | | |
| Customs district from which exported. | 1910 | | 1911 | | 1912 | | | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Atlantic ports..... | 3,003,430 | 306,122 | 1,564,485 | \$166,971 | 2,506,989 | \$257,792 | | |
| Gulf ports..... | 118,559 | 9,554 | 159,359 | 15,194 | 109,045 | 12,029 | | |
| Mexican border ports..... | 254,717 | 21,593 | 213,226 | 20,393 | 415,259 | 38,155 | | |
| Pacific ports..... | 60,450,100 | 5,974,196 | 36,663,729 | 3,834,584 | 40,391,058 | 4,312,116 | | |
| Northern border and Lake ports..... | 33,800 | 2,883 | | | 1,405 | 171 | | |
| | | | | | | | | |
| Customs district from which exported. | 1913 | | 1914 | | 1915 | | | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| New York..... | 1,935,881 | \$189,959 | 2,404,220 | \$207,924 | 5,316,456 | \$512,549 | | |
| New Orleans..... | | | 182,717 | 19,787 | 261,709 | 28,682 | | |
| El Paso..... | | | 120,140 | 9,045 | 176,390 | 12,348 | | |
| San Francisco..... | 31,687,771 | 3,277,811 | 38,844,912 | 3,696,936 | 35,321,058 | 4,209,944 | | |
| Oregon..... | 624,000 | 83,000 | 124,512 | 9,391 | 671,452 | 61,517 | | |
| Washington..... | 19,827,745 | 1,434,451 | 45,876,793 | 4,138,449 | 41,064,868 | 4,183,410 | | |
| All other districts..... | 1,215,396 | 118,089 | 197,716 | 14,061 | 634,183 | 60,663 | | |

^a Detailed statistics for 1900 to 1915, inclusive, may be found in "Pacific Salmon Fisheries," by John N. Cobb, Appendix III, Report U. S. Commissioner of Fisheries, 1916, pp. 194-198. Washington, 1917.

EXPORTS, BY CUSTOMS DISTRICTS, OF CANNED SALMON—Continued.

DETAILS, 1916 TO 1918.

| Customs district from which exported. | 1916 | | 1917 | | 1918 | |
|---------------------------------------|-------------|------------|-------------|------------|-------------|------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Georgia..... | | | 156,000 | \$37,052 | 96 | \$24 |
| Maine and New Hampshire..... | 2,583,306 | \$274,432 | 1,186,871 | 160,399 | 3,336 | 621 |
| Maryland..... | 517,800 | 47,603 | 1,884,672 | 168,537 | 1,208,142 | 149,080 |
| Massachusetts..... | 1,314,778 | 130,701 | 2,447,156 | 279,184 | 789,629 | 159,052 |
| New York..... | 24,257,388 | 2,339,629 | 23,993,032 | 2,607,602 | 49,034,077 | 7,690,025 |
| Philadelphia..... | 111,578 | 8,680 | 2,445,373 | 237,540 | 302,740 | 40,431 |
| Porto Rico..... | 9,813 | 578 | 3,060 | 384 | 6,106 | 839 |
| Virginia..... | 2,589,040 | 211,848 | 5,969,268 | 551,269 | 489,242 | 82,563 |
| Florida..... | 4,252 | 350 | 9,971 | 672 | 7,262 | 1,623 |
| Galveston..... | 3,211 | 159 | 30,096 | 3,467 | 16,457,201 | 2,124,530 |
| Mobile..... | 7,635 | 851 | 7,055 | 686 | 6,505 | 838 |
| New Orleans..... | 1,125,031 | 109,238 | 8,003,488 | 967,410 | 1,720,839 | 223,676 |
| Sabine..... | 4,867 | 428 | 8,244 | 1,233 | 5,411 | 1,325 |
| Arizona..... | 134,358 | 10,263 | 170,372 | 15,005 | 97,046 | 12,228 |
| Eagle Pass..... | 37,922 | 3,496 | 95,077 | 7,783 | | |
| El Paso..... | 117,715 | 8,876 | 196,331 | 15,878 | 105,630 | 12,547 |
| San Antonio..... | | | | | 401,640 | 47,445 |
| Laredo..... | 252,826 | 16,637 | 367,324 | 33,159 | | |
| Alaska..... | 87,371 | 6,319 | 3,094,290 | 267,489 | 5,396,783 | 691,837 |
| Hawaii..... | 78 | 15 | 137,328 | 13,959 | 56,044 | 8,195 |
| Oregon..... | 657,121 | 60,257 | 303,888 | 36,105 | | |
| San Francisco..... | 53,221,608 | 5,845,811 | 32,390,693 | 3,910,592 | 18,278,622 | 3,153,508 |
| Southern California..... | 33,455 | 2,463 | 35,133 | 3,758 | 30,009 | 4,327 |
| Washington..... | 60,520,904 | 5,461,097 | 30,549,747 | 3,034,487 | 13,783,070 | 1,874,726 |
| Buffalo..... | 850 | 107 | 5,437 | 722 | 250 | 25 |
| Dakota..... | | | 66,825 | 5,906 | 2,630 | 437 |
| Duluth and Superior..... | | | 171 | 39 | 15 | 1 |
| Michigan..... | 1,949,086 | 207,808 | 3,354,350 | 427,810 | 1,814,899 | 284,746 |
| Montana and Idaho..... | 3,389,969 | 283,727 | 987,925 | 166,323 | 1,248 | 222 |
| St. Lawrence..... | | | 100 | 28 | 61,990 | 5,901 |
| Vermont..... | 12,000 | 1,124 | 63,530 | 8,957 | 18 | 2 |
| Total..... | 152,943,962 | 15,032,497 | 117,962,807 | 12,963,425 | 110,060,480 | 16,570,834 |

In 1918 was inaugurated the practice of publishing customs figures for calendar years instead of, as previously, for the fiscal year ending June 30. The following tables show the exports of canned salmon by customs districts for the calendar years 1918 and 1919:

EXPORTS, BY CUSTOMS DISTRICTS, OF CANNED SALMON, CALENDAR YEARS 1918 AND 1919.

| Customs district from which exported. | 1918 | | 1919 | |
|---------------------------------------|------------|-----------|------------|------------|
| | Pounds. | Value. | Pounds. | Value. |
| Georgia..... | 99 | \$25 | | |
| Maine and New Hampshire..... | 96 | 24 | 130,994 | \$27,831 |
| Maryland..... | 1,705,877 | 220,669 | 2,385,585 | 411,895 |
| Massachusetts..... | 517,456 | 84,118 | 331,296 | 58,267 |
| New York..... | 46,490,264 | 7,500,562 | 85,463,019 | 13,977,432 |
| Philadelphia..... | 305,414 | 42,261 | 2,593,197 | 322,858 |
| Porto Rico..... | 1,711 | 394 | 7,458 | 1,262 |
| Virginia..... | 303,650 | 44,586 | 1,203,496 | 211,701 |
| Florida..... | | | 171,653 | 20,673 |
| Galveston..... | 15,169,801 | 1,942,094 | 11,156,255 | 1,357,799 |
| Mobile..... | 3,567,735 | 482,945 | 1,654,115 | 219,879 |
| New Orleans..... | 542,161 | 80,586 | 10,060,979 | 1,613,503 |
| Sabine..... | 3,033 | 833 | 16,439 | 3,354 |
| Arizona..... | 30,063 | 4,319 | 118,946 | 17,726 |
| El Paso..... | 21,290 | 2,891 | 320,836 | 41,491 |
| San Antonio..... | 46,914 | 7,373 | 855,588 | 116,612 |
| Alaska..... | 72 | 12 | 1,594,476 | 188,038 |
| Hawaii..... | 48,428 | 7,052 | 49,232 | 7,718 |
| Oregon..... | | | 244,600 | 56,680 |

EXPORTS, BY CUSTOMS DISTRICTS, OF CANNED SALMON, CALENDAR YEARS 1918
AND 1919—Continued.

| Customs district from which exported. | 1918 | | 1919 | |
|---------------------------------------|------------|------------|-------------|-------------|
| | Pounds. | Value. | Pounds. | Value. |
| San Francisco..... | 4,490,375 | \$749,095 | 19,596,548 | \$4,359,336 |
| Southern California..... | 34,045 | 5,159 | 125,793 | 21,856 |
| Washington..... | 16,422,108 | 1,764,105 | 27,911,740 | 4,930,335 |
| Buffalo..... | 501 | 75 | 863,795 | 140,568 |
| Dakota..... | 2,541 | 437 | 90,206 | 19,841 |
| Duluth and Superior..... | | | 13,460 | 2,996 |
| Michigan..... | 1,345,300 | 200,873 | 1,057,458 | 199,096 |
| Montana and Idaho..... | | | 1,527,576 | 281,707 |
| St. Lawrence..... | 52,800 | 8,819 | 163,063 | 26,108 |
| Vermont..... | | | 42,869 | 8,144 |
| Total..... | 91,101,734 | 13,149,307 | 169,750,672 | 28,644,706 |

EXPORTS OF DOMESTIC FRESH AND CURED SALMON.

The following table shows in summarized form the value of the exports of fresh and cured salmon, by countries to which exported, for the period 1900 to 1915, inclusive, and in detailed form for the years 1916 to 1919, inclusive. As with the canned salmon, the greater part of these exports go to European countries, Germany, under ordinary conditions, taking by far the largest quantity. A small portion of this is salmon caught in Atlantic waters.

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC PICKLED, FRESH, ETC., SALMON.

SUMMARY, FISCAL YEARS 1900 TO 1915.^a

| Country receiving. | 1900 | 1901 | 1902 | 1903 | 1904 | 1905 |
|--------------------|-----------|-----------|-----------|-----------|-------------|-------------|
| Europe..... | \$340,643 | \$344,368 | \$496,637 | \$760,197 | \$1,094,950 | \$1,748,039 |
| North America..... | 87,964 | 60,416 | 132,704 | 67,225 | 36,408 | 25,809 |
| South America..... | 1,702 | 901 | 3,063 | 1,600 | 1,822 | 3,438 |
| Asia..... | 3,324 | 15,037 | 25,843 | 5,393 | 1,382 | 30,170 |
| Oceania..... | 101,388 | 5,982 | 35,863 | 34,835 | 28,063 | 25,085 |
| Africa..... | 255 | 24 | 325 | 12 | 804 | 114 |

| Country receiving. | 1906 | 1907 | 1908 | 1909 | 1910 |
|--------------------|-------------|-------------|-------------|-------------|-------------|
| Europe..... | \$1,776,086 | \$1,794,885 | \$1,587,535 | \$1,225,948 | \$1,468,015 |
| North America..... | 36,943 | 23,204 | 27,263 | 28,383 | 29,688 |
| South America..... | 2,600 | 2,351 | 517 | 1,365 | 5,242 |
| Asia..... | 92,861 | 19,384 | 3,962 | 3,640 | 348 |
| Oceania..... | 18,914 | 38,721 | 28,767 | 28,935 | 28,079 |
| Africa..... | 60 | 198 | | 289 | 1,268 |

| Country receiving. | 1911 | 1912 | 1913 | 1914 | 1915 |
|--------------------|-------------|-------------|-------------|-------------|-------------|
| Europe..... | \$1,511,184 | \$1,587,973 | \$2,055,109 | \$2,074,499 | \$1,375,123 |
| North America..... | 24,880 | 20,350 | 34,741 | 86,087 | 20,336 |
| South America..... | 384 | 142 | 3,409 | 933 | 618 |
| Asia..... | 3,933 | 107 | 1,398 | 2,428 | 1,362 |
| Oceania..... | 32,334 | 21,575 | 25,699 | 31,330 | 27,420 |
| Africa..... | 424 | 4 | 2,210 | 32 | |

^a Detailed statistics for 1900 to 1915, inclusive, may be found in "Pacific Salmon Fisheries," by JOHN N. COBB, Appendix III, Report, U. S. Commissioner of Fisheries, 1916, pp. 198-201. Washington, 1917.

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC PICKLED, FRESH, ETC., SALMON—
Continued.

DETAILS, FISCAL YEARS 1916 TO 1918.

| Country receiving. | 1916 | 1917 | 1918 |
|---------------------------------------|-----------|----------|---------|
| EUROPE. | | | |
| Denmark..... | \$193,124 | \$33,874 | ..... |
| France..... | 2 | ..... | \$3,900 |
| Greece..... | 2,898 | 1,844 | ..... |
| Iceland, and Faroe Islands..... | 365 | 237 | ..... |
| Italy..... | ..... | 6,418 | 10 |
| Netherlands..... | 10,961 | 4,614 | ..... |
| Norway..... | 194,868 | 134,676 | ..... |
| Spain..... | 316 | ..... | ..... |
| Sweden..... | 145,613 | 27,346 | ..... |
| United Kingdom—England..... | 147,955 | 155,089 | 130,747 |
| NORTH AMERICA. | | | |
| Bermuda..... | 688 | 1,002 | 600 |
| British Honduras..... | 115 | 1 | 5 |
| Canada..... | 12,872 | 79,676 | 55,976 |
| Central American States: | | | |
| Costa Rica..... | 169 | 14 | ..... |
| Guatemala..... | 75 | 61 | 18 |
| Honduras..... | 149 | 112 | 5 |
| Nicaragua..... | 249 | 97 | 81 |
| Panama..... | 6,364 | 2,873 | 2,308 |
| Salvador..... | 117 | 76 | 3 |
| Mexico..... | 9,909 | 3,388 | 3,186 |
| Newfoundland and Labrador..... | 15 | ..... | ..... |
| West Indies: | | | |
| British— | | | |
| Barbados..... | 944 | 564 | 12 |
| Jamaica..... | 3,689 | 806 | 122 |
| Trinidad and Tobago..... | 102 | 1,635 | ..... |
| Other British..... | 1,352 | 801 | 26 |
| Cuba..... | 6,563 | 2,274 | 2,578 |
| Danish..... | 257 | 902 | 379 |
| Dominican Republic..... | 967 | 1,875 | 448 |
| Dutch..... | 574 | 382 | 52 |
| French..... | 61 | 65 | ..... |
| Haiti..... | 525 | 435 | 290 |
| SOUTH AMERICA. | | | |
| Argentina..... | 111 | 140 | 9 |
| Bolivia..... | 87 | 129 | 35 |
| Brazil..... | 424 | 537 | 112 |
| Chile..... | 735 | 30 | 243 |
| Colombia..... | 1,164 | 435 | 869 |
| Ecuador..... | 263 | 45 | 31 |
| Guiana: | | | |
| British..... | 940 | 158 | ..... |
| Dutch..... | 380 | 817 | 6 |
| French..... | 407 | 230 | 25 |
| Peru..... | 929 | 742 | ..... |
| Uruguay..... | 95 | ..... | ..... |
| Venezuela..... | 2,998 | 779 | 362 |
| ASIA. | | | |
| China..... | 23 | 111 | 95 |
| China, leased territory—Japanese..... | ..... | 109 | ..... |
| Chosen..... | 7 | ..... | 4 |
| East Indies: | | | |
| British— | | | |
| British India..... | 102 | 22 | 22 |
| Straits Settlements..... | ..... | ..... | 50 |
| Other British..... | 9 | ..... | ..... |
| Dutch..... | 1,735 | ..... | 438 |
| French..... | ..... | 35 | ..... |
| Hongkong..... | 43 | 9 | ..... |
| Japan..... | 22 | 56 | 286 |
| Russia in Asia..... | 243 | ..... | ..... |
| OCEANIA. | | | |
| British: | | | |
| Australia..... | 31,815 | 21,058 | 155 |
| New Zealand..... | 81 | 23 | ..... |
| Other British..... | 61 | 86 | 73 |
| French..... | 1,285 | 1,039 | 235 |
| German..... | 442 | 1,062 | 1,363 |
| Philippine Islands..... | 252 | 1,071 | 135 |

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC PICKLED, FRESH, ETC., SALMON—
Continued.

DETAILS, FISCAL YEARS 1916 TO 1918—Continued.

| Country receiving. | 1916 | 1917 | 1918 |
|------------------------|---------|---------|---------|
| AFRICA. | | | |
| British Africa: | | | |
| West..... | | \$376 | \$152 |
| South..... | \$1,642 | 877 | |
| (Canary Islands..... | 87 | 1,140 | |
| Egypt..... | | 479 | |
| Liberia..... | 6 | | |
| Portuguese Africa..... | 1,251 | 47 | |
| Spanish Africa..... | 701 | | |
| Total..... | 790,198 | 492,879 | 205,446 |
| RECAPITULATION. | | | |
| Europe..... | 696,102 | 364,098 | 134,657 |
| North America..... | 45,756 | 97,139 | 66,089 |
| South America..... | 8,533 | 4,051 | 1,692 |
| Asia..... | 2,184 | 333 | 895 |
| Oceania..... | 33,936 | 24,339 | 1,961 |
| Africa..... | 3,687 | 2,919 | 152 |

DOMESTIC PICKLED SALMON, CALENDAR YEARS 1918 AND 1919.^a

| Country receiving. | 1918 | | 1919 | |
|--------------------------------------|-----------------------|----------|-----------------------|---------|
| | Barrels. ^b | Value. | Barrels. ^b | Value. |
| EUROPE. | | | | |
| Azores, and Madeira Islands..... | | | 2 | \$62 |
| Belgium..... | | | 1 | 35 |
| Denmark..... | | | 10,044 | 466,359 |
| Germany..... | | | 2,307 | 41,538 |
| Greece..... | | | 109 | 3,879 |
| Netherlands..... | | | 270 | 15,995 |
| Norway..... | | | 2,514 | 123,069 |
| Spain..... | | | 1 | 29 |
| Sweden..... | | | 2,178 | 105,010 |
| United Kingdom: | | | | |
| England..... | 419 | \$17,800 | 2,210 | 124,152 |
| Scotland..... | | | 101 | 2,830 |
| NORTH AMERICA. | | | | |
| Bermuda..... | | | 37 | 662 |
| British Honduras..... | | | 1 | 20 |
| Canada..... | 66 | 1,300 | 272 | 5,031 |
| Central American States: | | | | |
| Costa Rica..... | | | 3 | 66 |
| Guatemala..... | 5 | 138 | 5 | 199 |
| Honduras..... | 1 | 6 | | 59 |
| Nicaragua..... | | | | 846 |
| Panama..... | 31 | 817 | 28 | 36 |
| Mexico..... | 5 | 104 | 2 | |
| West Indies: | | | | |
| British— | | | | |
| Barbados..... | 7 | 176 | 301 | 11,380 |
| Jamaica..... | 1 | 17 | 18 | 390 |
| Trinidad and Tobago..... | 6 | 115 | 659 | 18,148 |
| Other British..... | 3 | 59 | 9 | 243 |
| Cuba..... | 17 | 452 | 31 | 1,008 |
| Danish..... | 18 | 350 | | |
| Dominican Republic..... | 54 | 1,180 | 35 | 1,004 |
| Dutch..... | 2 | 20 | 13 | 213 |
| French..... | 2 | 46 | 19 | 547 |
| Haiti..... | 24 | 497 | 20 | 652 |
| Virgin Islands of United States..... | | | 20 | 454 |

^a Included in "All others" in previous years.^b Barrel holds 200 pounds of fish.

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC PICKLED, FRESH, ETC., SALMON—
Continued.

DOMESTIC PICKLED SALMON, CALENDAR YEARS 1918 AND 1919—Continued.

| Country receiving. | 1918 | | 1919 | |
|---------------------------|----------|--------|----------|---------|
| | Barrels. | Value. | Barrels. | Value. |
| SOUTH AMERICA. | | | | |
| Colombia..... | 1 | \$20 | 2 | \$36 |
| Guiana: | | | | |
| British..... | 14 | 369 | 10 | 270 |
| Dutch..... | 15 | 386 | 101 | 2,726 |
| French..... | 35 | 865 | 35 | 1,186 |
| Peru..... | | | 3 | 72 |
| Venezuela..... | 2 | 42 | 1 | 50 |
| ASIA. | | | | |
| China..... | 9 | 210 | 3 | 86 |
| Japan..... | | | 93 | 1,864 |
| OCEANIA. | | | | |
| British: | | | | |
| Australia..... | 1,058 | 23,704 | 736 | 16,292 |
| New Zealand..... | 1 | 28 | | |
| Other British..... | 2 | 35 | 3 | 70 |
| French..... | 44 | 937 | 29 | 692 |
| German..... | 75 | 1,645 | 19 | 413 |
| Philippine Islands..... | 3 | 63 | | |
| AFRICA. | | | | |
| British South Africa..... | | | 1 | 32 |
| Liberia..... | 2 | 20 | 7 | 69 |
| Total..... | 1,922 | 51,401 | 22,256 | 947,694 |
| RECAPITULATION. | | | | |
| Europe..... | 419 | 17,800 | 19,737 | 882,958 |
| North America..... | 242 | 5,277 | 1,476 | 40,878 |
| South America..... | 67 | 1,682 | 152 | 4,340 |
| Asia..... | 9 | 210 | 96 | 1,950 |
| Oceania..... | 1,183 | 26,412 | 787 | 17,467 |
| Africa..... | 2 | 20 | 8 | 101 |

The following table gives a summary, by customs districts, of the exports of domestic fresh and cured salmon from 1900 to 1915, inclusive, and a detailed statement of the same for the years 1916 to 1919, inclusive. The greater part of the shipments pass through the New York City customs district.

EXPORTS, BY CUSTOMS DISTRICTS, OF DOMESTIC PICKLED, FRESH, ETC., SALMON.

SUMMARY, FISCAL YEARS 1900 TO 1915.^a

| Customs district from which exported. | 1900 | 1901 | 1902 | 1903 | 1904 | 1905 | |
|---------------------------------------|-------------|-------------|-------------|---------------------------------------|-------------|-------------|-------------|
| Atlantic ports..... | \$346,924 | \$330,890 | \$503,439 | \$767,397 | \$1,103,034 | \$1,757,832 | |
| Gulf ports..... | | 5 | 143 | 30 | 124 | 159 | |
| Mexican border ports..... | 1,192 | 535 | 1,837 | 1,227 | 1,160 | 997 | |
| Pacific ports..... | 185,644 | 92,698 | 188,177 | 99,018 | 56,167 | 66,772 | |
| Northern border and Lake ports..... | 1,516 | 2,610 | 819 | 1,680 | 3,004 | 6,895 | |
| | | | | | | | |
| Customs district from which exported. | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 |
| Atlantic ports..... | \$1,781,476 | \$1,797,411 | \$1,500,778 | \$1,230,542 | \$1,479,656 | \$1,514,599 | \$1,586,319 |
| Gulf ports..... | 14 | 276 | 7,226 | 49 | 74 | 1,542 | ..... |
| Mexican border ports..... | 788 | 424 | 167 | 25 | 202 | 18 | 202 |
| Pacific ports..... | 139,606 | 73,927 | 44,313 | 50,834 | 50,521 | 46,167 | 33,190 |
| Northern border and Lake ports..... | 5,580 | 6,705 | 5,560 | 7,110 | 2,187 | 10,813 | 10,440 |
| | | | | | | | |
| Customs district from which exported. | 1913 | 1914 | 1915 | Customs district from which exported. | 1913 | 1914 | 1915 |
| New York..... | \$2,060,068 | \$2,067,366 | \$1,377,840 | San Francisco.... | \$26,030 | \$29,880 | \$28,777 |
| Alaska..... | 20,995 | 16,932 | 6,630 | All other districts | 8,119 | 21,418 | 9,592 |
| Puget Sound..... | 7,354 | 59,713 | 2,020 | | | | |

DETAILS, FISCAL YEARS 1916 TO 1918.

| Customs district from which exported. | 1916 | 1917 | 1918 |
|---------------------------------------|---------|----------|---------|
| Maine and New Hampshire..... | \$16 | \$22,480 | \$37 |
| Massachusetts..... | 2,925 | 14,764 | 32,002 |
| New York..... | 732,782 | 360,348 | 106,636 |
| Porto Rico..... | 47 | 635 | 57 |
| Florida..... | 60 | ..... | 210 |
| Mobile..... | 48 | 5 | 5 |
| New Orleans..... | 610 | 166 | 408 |
| Sabine..... | 33 | ..... | 950 |
| Arizona..... | 1,739 | 374 | 501 |
| Eagle Pass..... | ..... | 454 | ..... |
| El Paso..... | ..... | 276 | 24 |
| San Antonio..... | ..... | ..... | 1,123 |
| Laredo..... | 16 | 100 | ..... |
| Alaska..... | 5,203 | 20,348 | 14,529 |
| Hawaii..... | 16 | 15 | 7 |
| San Francisco..... | 33,648 | 23,504 | 6,907 |
| Southern California..... | 80 | 255 | 191 |
| Washington..... | 1,155 | 4,770 | 19,825 |
| Buffalo..... | 394 | 2,933 | 6,450 |
| Dakota..... | 706 | 2,233 | 1,942 |
| Duluth and Superior..... | 13 | 42 | 251 |
| Michigan..... | 8,845 | 12,695 | 11,910 |
| Montana and Idaho..... | ..... | 5,567 | 49 |
| St. Lawrence..... | 1,300 | 7,167 | 1,258 |
| Vermont..... | 565 | 4,433 | 174 |
| Total..... | 790,198 | 492,879 | 205,446 |

^a A more detailed statement for 1900 to 1912 may be found in "Pacific Salmon Fisheries," by John N. Cobb, Appendix III. Report U. S. Commissioner of Fisheries, 1916, pp. 202-203. Washington, 1917.

EXPORTS, BY CUSTOMS DISTRICTS, OF DOMESTIC PICKLED, FRESH, ETC., SALMON—Continued.

DOMESTIC PICKLED SALMON, CALENDAR YEARS 1918 AND 1919.

| Customs district from which exported. | 1918 | | 1919 | |
|---------------------------------------|----------|----------|----------|---------|
| | Barrels. | Value. | Barrels. | Value. |
| Maine and New Hampshire | | | 120 | \$2,220 |
| Massachusetts | | | 2 | 65 |
| New York | 657 | \$23,346 | 21,041 | 919,375 |
| Porto Rico | 1 | 23 | | |
| Philadelphia | | | 44 | 3,500 |
| New Orleans | 2 | 39 | 7 | 163 |
| Alaska | 40 | 770 | 4 | 100 |
| San Francisco | 1,185 | 26,443 | 797 | 17,724 |
| Southern California | 3 | 58 | 2 | 36 |
| Washington | 20 | 458 | 100 | 2,017 |
| Dakota | 6 | 91 | 125 | 2,112 |
| Duluth and Superior | 2 | 60 | | |
| Michigan | 3 | 53 | 4 | 168 |
| Montana and Idaho | | | 1 | 34 |
| St. Lawrence | 3 | 60 | 9 | 180 |
| Total | 1,922 | 51,401 | 22,256 | 947,694 |

EXPORTS, BY COUNTRIES RECEIVING, OF ALL OTHER SALMON, CALENDAR YEAR 1919.

| Country receiving. | Value. | Country receiving. | Value. |
|----------------------------|---------|---------------------------------|---------|
| Belgium | \$1,230 | Virgin Islands of United States | \$241 |
| Denmark | 75,095 | Bolivia | 2 |
| France | 6,444 | Brazil | 2,194 |
| Iceland, and Faroe Islands | 200 | Chile | 190 |
| Netherlands | 617 | Colombia | 182 |
| Norway | 43,840 | Dutch Guiana | 238 |
| Spain | 16 | French Guiana | 135 |
| Sweden | 2,430 | Peru | 10 |
| United Kingdom—England | 251,730 | Venezuela | 49 |
| Bermuda | 25 | China | 286 |
| Canada | 421,498 | British Straits Settlements | 29 |
| Guatemala | 96 | Other British East Indies | 3 |
| Honduras | 5 | Dutch East Indies | 749 |
| Nicaragua | 21 | French East Indies | 5 |
| Panama | 646 | Japan | 6,214 |
| Salvador | 26 | Russia in Asia | 67 |
| Mexico | 13,884 | Siam | 3 |
| Barbados | 4,000 | Australia | 4,840 |
| Jamaica | 108 | French Oceania | 134 |
| Trinidad and Tobago | 16 | German Oceania | 36 |
| Other British West Indies | 15 | Philippine Islands | 1,513 |
| Cuba | 1,643 | British West Africa | 381 |
| Dominican Republic | 525 | French Africa | 450 |
| Dutch West Indies | 110 | | |
| French West Indies | 255 | | |
| Haiti | 38 | Total | 842,464 |

EXPORTS, BY CUSTOMS DISTRICTS, OF ALL OTHER SALMON, CALENDAR YEAR 1919.

| Customs district. | Value. | Customs district. | Value. |
|-------------------------|----------|---------------------|---------|
| Maine and New Hampshire | \$72,305 | Southern California | \$315 |
| Massachusetts | 18,986 | Washington | 13,861 |
| New York | 218,204 | Buffalo | 5,964 |
| Philadelphia | 44,625 | Dakota | 4,250 |
| Porto Rico | 199 | Duluth and Superior | 44 |
| Florida | 4 | Michigan | 13,591 |
| New Orleans | 4,049 | Montana and Idaho | 12,283 |
| Sabine | 29 | Ohio | 123 |
| Arizona | 65 | St. Lawrence | 29,252 |
| El Paso | 5 | Vermont | 2,831 |
| San Antonio | 13,365 | | |
| Alaska | 347,068 | Total | 842,464 |
| San Francisco | 41,046 | | |

IMPORTS OF FRESH SALMON.

For some years it was the custom of the canneries on Puget Sound, when fish were scarce on the American side and abundant on the Canadian side, to import fresh salmon to fill out the domestic supply and the Canadian canneries would do the same when the conditions were reversed. In 1904 the Canadian Government prohibited the export of fresh sockeye salmon to Puget Sound for packing purposes, and in 1910 an effort was made to have Congress retaliate by enacting a similar law for this side of the line, but the bill failed of passage.

The table below shows the yearly imports of fresh salmon from British Columbia:

IMPORTS OF FRESH SALMON FROM BRITISH COLUMBIA, CANADA, FOR A SERIES OF YEARS.^a

| Year. | Pounds. | Value. | Year. | Pounds. | Value. | Year. | Pounds. | Value. |
|-----------|---------|--------|-----------|---------|---------|-----------|-----------|---------|
| 1890..... | 4,690 | \$241 | 1897..... | 93,454 | \$2,681 | 1904..... | 40,610 | \$1,025 |
| 1891..... | 4,950 | 170 | 1898..... | 11,790 | 278 | 1905..... | 1,015 | 35 |
| 1892..... | 6,288 | 301 | 1899..... | 58,042 | 4,191 | 1906..... | 3,457,738 | 64,408 |
| 1893..... | 64,811 | 3,730 | 1900..... | 17,494 | 825 | 1907..... | 113,224 | 4,131 |
| 1894..... | 3,872 | 219 | 1901..... | 27,972 | 2,050 | 1908..... | 8,880 | 795 |
| 1895..... | 14,000 | 1,404 | 1902..... | 22,354 | 799 | 1909..... | 41,073 | 2,346 |
| 1896..... | 11,799 | 419 | 1903..... | 6,890 | 343 | 1910..... | 198,251 | 10,116 |

^a After 1909 all imports of fresh salmon are listed under "Fish, fresh."

After 1911 the imports of fresh salmon from both coasts of Canada and from Newfoundland were lumped together, and are shown in the table below. Fully nine-tenths, if not more, of this salmon came from the Province of British Columbia in Canada, and the greater part of this was canned in the canneries on Puget Sound, Wash.

| Fiscal year ending June 30— | Pounds. | Value. | Fiscal year ending June 30— | Pounds. | Value. | Fiscal year ending June 30— | Pounds. | Value. |
|-----------------------------|-----------|-----------|-----------------------------|------------|-----------|-----------------------------|------------|-----------|
| 1911..... | 1,122,286 | \$114,123 | 1914..... | 3,262,824 | \$245,791 | 1917..... | 19,769,090 | \$569,442 |
| 1912..... | 1,520,657 | 135,416 | 1915..... | 10,676,296 | 383,697 | 1918..... | 14,408,294 | 957,169 |
| 1913..... | 2,089,761 | 189,513 | 1916..... | 24,026,481 | 501,115 | 1919..... | 15,571,451 | 928,552 |

The following table shows, by customs districts, the imports of fresh salmon during the calendar year 1918:

IMPORTS, BY CUSTOMS DISTRICTS, OF FRESH SALMON, CALENDAR YEAR 1918.

| Customs district. | Pounds. | Value. | Customs district. | Pounds. | Value. |
|------------------------------|------------|----------|--------------------------|------------|----------|
| Maine and New Hampshire..... | 449,244 | \$82,721 | Dakota..... | 532,722 | \$56,172 |
| Massachusetts..... | 4,965 | 318 | Duluth and Superior..... | 18,100 | 1,728 |
| New York..... | 12,400 | 3,636 | St. Lawrence..... | 247,533 | 26,918 |
| Philadelphia..... | 1,540 | 495 | Vermont..... | 339,306 | 37,216 |
| Washington..... | 11,479,858 | 421,713 | Total..... | 13,985,998 | 631,119 |
| Buffalo..... | 20 | 2 | | | |

During the calendar year 1919, imports of fresh salmon amounted to 752,480 pounds, valued at \$101,121, and during the calendar year 1920, to 676,359 pounds, valued at \$125,863.

IMPORTS OF CURED SALMON.

Below are shown the imports into this country of foreign-cured salmon, the product of the Pacific salmon fisheries, from 1886 to 1909, inclusive.

IMPORTS OF FOREIGN PICKLED PACIFIC SALMON, 1886 TO 1909.^a

| Year. | British Columbia. | | Japan. | | Hongkong. | | Russia, Asiatic. | | Total. | |
|-----------|-------------------|--------|---------|--------|-----------|--------|------------------|--------|---------------------|--------------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| 1886..... | 5,600 | \$224 | | | | | | | 5,600 | \$224 |
| 1887..... | 200 | 4 | | | | | | | 200 | 4 |
| 1888..... | 86,000 | 4,031 | | | | | | | 86,000 | 4,031 |
| 1889..... | 18,200 | 860 | | | | | | | 18,200 | 860 |
| 1890..... | 600 | 36 | | | | | | | 600 | 36 |
| 1891..... | 200 | 5 | | | | | | | 200 | 5 |
| 1893..... | 5,478 | 291 | | | | | | | 5,478 | 291 |
| 1894..... | 149,410 | 17,592 | | | 1,200 | \$29 | 11,875 | \$298 | 162,485 | 17,919 |
| 1895..... | 6,550 | 250 | | | 600 | 13 | | | 7,150 | 263 |
| 1896..... | 6,530 | 474 | | | | | | | 6,530 | 474 |
| 1897..... | 6,890 | 156 | | | | | | | 6,890 | 156 |
| 1898..... | 4,145 | 188 | | | 30 | 2 | 9,870 | 266 | 14,045 | 456 |
| 1899..... | 15,875 | 1,554 | | | | | | | ^b 16,032 | ^b 1,560 |
| 1900..... | 162,558 | 11,061 | 600 | \$41 | | | | | 163,158 | 11,102 |
| 1901..... | 165,243 | 11,225 | | | | | | | 165,243 | 11,225 |
| 1902..... | 175,411 | 13,794 | 606 | 28 | | | | | 176,017 | 13,822 |
| 1903..... | 161,549 | 11,756 | 360 | 18 | | | | | 161,909 | 11,774 |
| 1904..... | 282,210 | 23,319 | 1,400 | 52 | | | | | 283,610 | 23,371 |
| 1905..... | 282,027 | 25,584 | 3,015 | 133 | | | | | 285,042 | 25,717 |
| 1906..... | 35,475 | 1,730 | 5,510 | 175 | | | | | 40,985 | 1,905 |
| 1907..... | 6,393 | 322 | 680 | 31 | | | | | 7,073 | 353 |
| 1908..... | 13,230 | 631 | 4,185 | 174 | | | | | 17,415 | 805 |
| 1909..... | 30,710 | 1,523 | 3,537 | 148 | | | | | 34,247 | 1,617 |
| 1910..... | 111,645 | 5,505 | | | | | | | | |

^a After 1909 all imports of salmon, pickled or salted, are included under "All other cured or preserved."

^b Includes 157 pounds, valued at \$6, from China.

Since 1910 all imports of pickled salmon have been lumped together and it has been impossible to distinguish the imports of Pacific salmon from those imported from Atlantic districts. The table below shows the total imports, almost all of which comprise salmon from the Province of British Columbia in the Dominion of Canada.

| Fiscal year ending June 30— | Pounds. | Value. | Fiscal year ending June 30— | Pounds. | Value. | Fiscal year ending June 30— | Pounds. | Value. |
|-----------------------------|---------|----------|-----------------------------|-----------|----------|-----------------------------|---------|----------|
| 1911..... | 695,878 | \$62,769 | 1914..... | 1,114,927 | \$84,503 | 1917..... | 945,394 | \$81,776 |
| 1912..... | 417,938 | 33,901 | 1915..... | 1,162,341 | 104,451 | 1918..... | 739,759 | 74,042 |
| 1913..... | 344,530 | 28,650 | 1916..... | 1,010,844 | 70,837 | 1919..... | 859,276 | 117,352 |

EXPORTS OF CANADIAN CANNED SALMON.

EXPORTS OF CANNED SALMON FROM CANADA, 1916-1919.

[Fiscal year ended Mar. 31.]

| Destination. | 1916 | 1917 | 1918 | 1919 |
|--------------------------------|----------------|----------------|----------------|----------------|
| | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> |
| Australia..... | 4,789,094 | 3,365,149 | 2,236,742 | 3,750,194 |
| Barbados..... | | | | 1,642 |
| Bermuda..... | 11,480 | 10,934 | 9,132 | 25,884 |
| Bolivia..... | | 9,600 | | 120,000 |
| British Guiana..... | | 48 | | 96 |
| British India..... | 298,200 | 101,344 | 2,400 | 55,950 |
| British South Africa..... | 52,800 | | | 48,000 |
| British West Indies..... | 28,043 | 116,112 | 48,238 | |
| Chile..... | | 14,400 | | 614,016 |
| China..... | 11,976 | 1,440 | 101 | 2,540 |
| Cuba..... | | | | 1,048,800 |
| Dutch East Indies..... | 343,632 | 319,344 | 47,768 | 28,800 |
| Ecuador..... | | | | 2,400 |
| Fiji..... | 928,752 | 880,400 | 736,616 | 354,196 |
| France..... | 3,905,461 | 5,521,100 | 13,529,569 | 2,869,658 |
| French Oceania..... | | 14,400 | 48,000 | |
| Greenland, Iceland, etc..... | | | 200 | |
| Hongkong..... | 18,240 | | 7,300 | 15,550 |
| Italy..... | | 60 | 3,109,694 | 5,454,670 |
| Jamaica..... | | | | 576 |
| Japan..... | | | | 192 |
| Newfoundland..... | | | 120 | 48,000 |
| New Zealand..... | 1,338,050 | 1,339,282 | 1,680,652 | 1,623,496 |
| Other British East Indies..... | | | | 36,000 |
| Other British Oceania..... | 91,056 | 105,360 | 6,000 | 12,000 |
| Other British West Indies..... | | | | 8,646 |
| Panama..... | | 4,760 | | |
| Peru..... | | 21,600 | | |
| Russia in Europe..... | | | | 48,000 |
| Siam..... | 14,400 | 124,848 | | 24,096 |
| St. Pierre and Miquelon..... | 2,391 | 1,351 | 1,869 | 4,784 |
| Straits Settlements..... | 2,064,736 | 1,060,018 | 292,800 | 412,810 |
| Switzerland..... | 192 | | | |
| Trinidad and Tobago..... | | | | 240 |
| United Kingdom..... | 35,225,051 | 34,772,879 | 21,117,314 | 29,265,108 |
| United States..... | 18,725 | 597,758 | 893,639 | 1,936,753 |
| Total..... | 49,142,882 | 48,332,127 | 43,777,154 | 47,813,697 |

SALMON CULTURE.^a

The artificial culture of salmon on the Pacific coast has developed into a large and constantly expanding industry. The United States Bureau of Fisheries operates a number of large and well-equipped hatcheries, while the State governments of California, Oregon, and Washington, the Dominion of Canada and the Province of British Columbia, and certain private companies have built and maintain a large number of hatcheries, some of these being among the largest in the world.

OBTAINING THE SPAWNING FISH.

The eggs used for artificial propagation are obtained from salmon taken on their way upstream to the natural spawning grounds. In order to arrest the ascent of the fish a rack is usually built across the stream. Where this is not feasible a trap is sometimes constructed for the purpose of catching the fish. Sometimes the racks have slat traps attached in which some fish are caught.

^a Since this revision was completed there has appeared an excellent work on this subject, entitled "Artificial Propagation of the Salmon of the Pacific Coast," revised and enlarged by Henry O'Malley. Appendix II, Report, U. S. Commissioner of Fisheries, 1919, 32 pp., 9 pls. Washington, 1920.

A number of methods have been employed for taking the fish as they are grouped below the rack and seeking for an opening, but the most practicable has been found to be by means of drag or haul seines swept across the area just below the rack. When the pocket or bunt is brought close to shore the workmen pick out the ripe fish and turn the others back to remain until they reach this stage. The ripe fish are placed in pens or live boxes made for this purpose, the males and females being kept separate. These live boxes are usually on the under side of a floating platform, and are accessible through hinged covers set in the plank flooring. Projecting beyond this platform is usually another, upon which the actual work of stripping the fish and caring for the pans is performed.

At a few places where the fish are caught before they have reached the ripe stage, notably Karluk, the fish are placed in a pound or corral and held until they become ripe. This method is resorted to only in case of necessity.

The surest sign of ripeness in a female is the separation of the eggs in the ovaries, but the experienced spawn taker can, from the general appearance of the fish, usually tell whether she is ripe or not, according to Bower:^a

An interesting experiment was conducted at the Afognak station last season [1910] to determine the degree of ripeness producing the best quality of eggs. The loss on the lot taken from females which were dead ripe—eggs flowing very freely—was less than 1 per cent. while with another lot, where the females were ordinarily ripe upon testing in the usual manner, the loss was about 5 per cent. This shows the need of caution in having fish fully ripe before stripping, if the highest degree of efficiency is to be expected.

TAKING THE EGGS.

As the eggs of the females confined in pens are likely to be injured within the fish, stripping is usually done every day.

When ready for spawn taking, one man lifts a female from the live box by means of a small dip net, while another man lifts out a male in the same manner. They are held suspended in the net until their violent struggles are over, when it is easy to handle them.

For many years, and even yet at many hatcheries, the method of taking salmon spawn has been by pressing the eggs out by steady downward pressure on the belly of the fish. The milt from the male is obtained in the same way.

Where the force is large and the fish rather small the quickest way is for one to hold the fish in one hand and press out the eggs or milt with the other. When the fish are large, or the working force is small, a strait-jacket is used. This is a sort of trough made about the average length of the salmon and hollowed out to fit its general shape. A permanent cleat is set across the lower end, while at the upper end is a strip with a buckle. The fish is slid into the trough, the tail going below the cleat, where it is securely held, and the head buckled in at the upper end with the strap. In this condition the fish is unable to do any harm by its struggles and the eggs can be pressed out at leisure.

^a Fish Culture in Alaska, by Ward T. Bower. In *Alaska Fisheries and Fur Industries in 1911*, by B. W. Evermann. U. S. Bureau of Fisheries Document No. 766, p. 70. Washington, 1912.



FIG. 40.—STRIPPING SALMON WITH AID OF STRAIT JACKET.



FIG. 41.—CHEHALIS HATCHERY, WASHINGTON FISH AND GAME COMMISSION, SHOWING RACKS TO PREVENT SALMON FROM GOING UPSTREAM, AND PEN FOR HOLDING SPAWNING FISH.

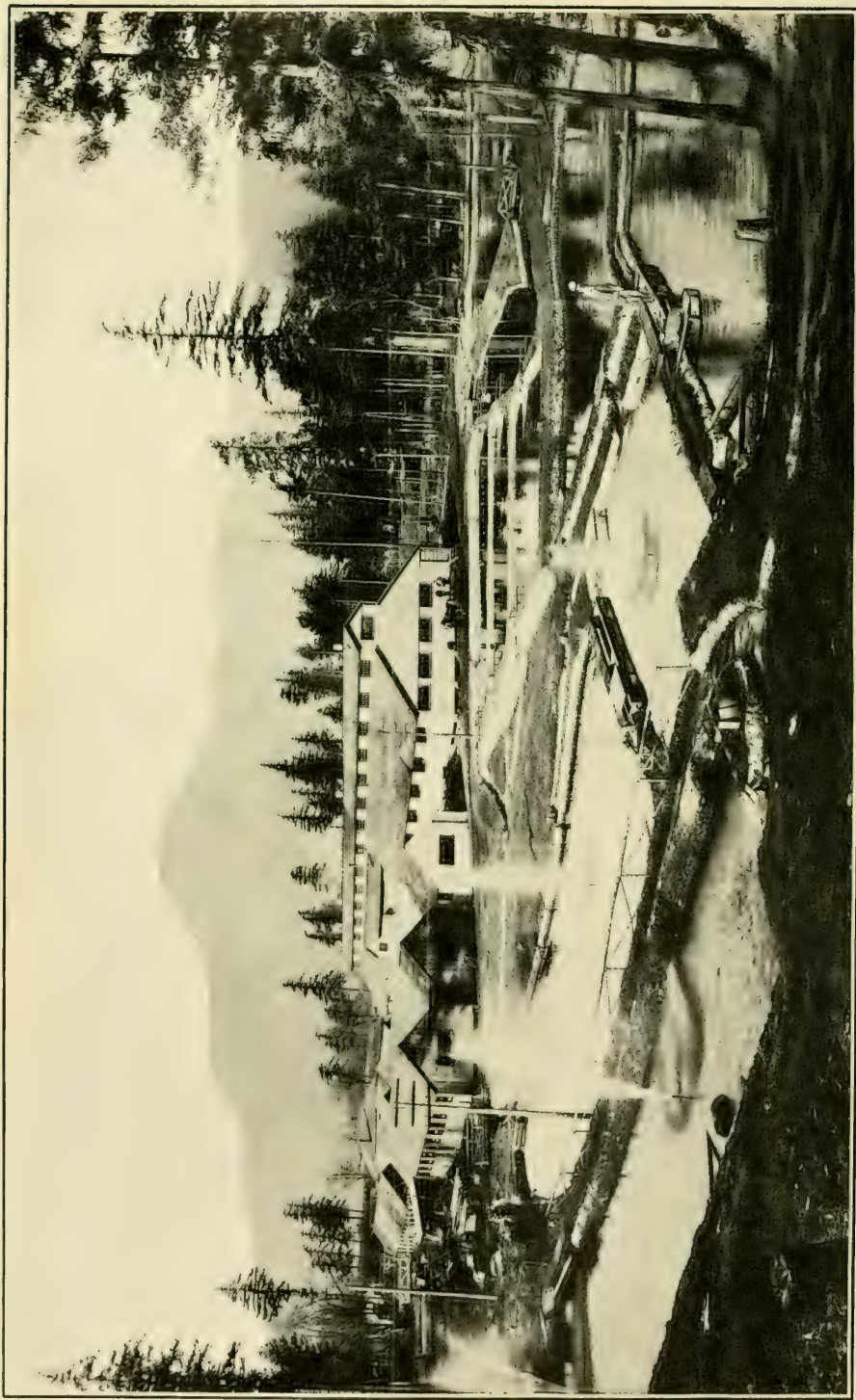


FIG. 42.—BONNEVILLE SALMON HATCHERY OF THE OREGON FISH AND GAME COMMISSION, SHOWING REARING PONDS.

A more modern method in use at many hatcheries, which has been well described by Mr. Bower,^a is as follows:

The long-followed process of taking Pacific salmon eggs by hand expression has been superseded in the last few years by the method of incision, a method discovered and developed by the late Cloudsley Rutter in connection with his study of the life history of the salmon of the Sacramento River. This consists simply of making a cut in the abdominal walls from the throat or near the pectoral fins to the vent, the fish just previously having been killed by a blow on the back of the head. When making the cut the knife is either shielded by a guard or is so held between the thumb and forefinger as to allow not more than half an inch of the blade to project, thus precluding the possibility of injuring any of the eggs. Immediately following the incision the eggs flow in a mass into the spawning pan beneath. The operator's fingers are inserted into the abdominal cavity gently to assist in removing any eggs that may be enfolded in the organs or that may merely adhere to the walls of the cavity. Fertilization is accomplished in the usual manner.

Care must be exercised not to tear loose from the ovaries any eggs that do not come freely when the organs are moved from side to side by the fingers. Eggs thus torn loose are immature, and if taken it becomes necessary to eliminate them subsequently in the hatchery. It is preferable also to have the fish either in a vertical position or with the head considerably higher than the tail, that gravity may assist the flow of eggs.

It was at first thought necessary—and the practice still obtains at some stations—to bleed the fish either by cutting off the head or tail before making the incision. Experimentation, however, has conclusively demonstrated that no advantage results from this procedure, as the few drops of blood that may occasionally fall into a pan of eggs result in no harm. The extra labor involved in bleeding may therefore be dispensed with entirely.

When taken by the method of incision the eggs are of greatly improved quality; there is no straining or rupture of good eggs as is inevitably the result when heavy hand pressure is exerted; no unripe eggs are torn from the ovaries; and at the same time there is no waste of good eggs left enfolded in the organs, as is certain to be the case in stripping by hand. The improvement in quality is from 5 to 10 per cent and the saving in labor, too, is of noteworthy consideration.

The taking of Pacific salmon eggs by incision marks so distinct an advance in fish culture that it is no longer permissible to continue the obsolete method of stripping by hand.

FERTILIZING THE EGGS.^b

In impregnating the eggs the main object is to bring the milt and the eggs together as quickly as possible after they have left the fish. By some persons a little water is considered desirable to give greater activity to the milt, but if left more than a minute in the water there is a decided loss of fertilizing power. The eggs do not suffer so quickly from immersion in water. The absorbing property which they possess when they first leave the parent fish, and which attracts to the micropyle the spermatozoa, lasts several minutes, but it is not prudent to leave the eggs in the water a moment longer than is necessary before adding the milt.

The addition of the water is not essential to a good impregnation; in some instances better results are secured without the use of water and, after all, if the main object is secured, of bringing the milt and the eggs together with the slightest possible delay after they leave the fish, it makes very little difference whether water is used or not. The milt retains its fertilizing power several days when kept from air and water, and impregnation can be effected between fishes widely separated by merely forwarding the milt properly sealed. At Baird impregnation by the dry method, which has always been followed there, has resulted in the fertilization of about 90 per cent of the eggs so treated.

The Russian or dry method of impregnating eggs consists simply in taking both the eggs and the milt in a moist pan. It may be urged as an objection to this method that the eggs will be injured by striking against the pan, but it is a fact that although the same eggs would be destroyed by the concussion a week later, or even 24 hours later, they do not suffer in the least from it at the moment of extrusion from the fish.

It was at one time considered an important question whether the eggs or milt should be taken first, but with the dry method it makes no difference, as, either way, both eggs and milt remain operative long enough for all practical purposes of impregnation.

^a Fish Culture in Alaska, by Ward T. Bower. In Alaska Fisheries and Fur Industries in 1911, by B. W. Evermann. U. S. Bureau of Fisheries Document No. 766, pp. 80, 81. Washington, 1912.

^b A Manual of Fish-culture, Based on the Methods of the U. S. Commission of Fish and Fisheries, revised edition, pp. 10-12. Washington, 1900.

Various methods of treating the eggs in the pan after impregnation has taken place have been tried. Some operators leave the eggs in the pans as first taken with the milt for two or three minutes and then add water, after which they are left to stand in the pan until they separate, when they are washed clean, taken to the hatching house, and placed in the troughs. Others pour the contents of the several pans—eggs, milt, and all—into a large can after the eggs become impregnated, and when the eggs separate the contents of the can are poured into the hatching troughs, trusting to the current in the troughs to wash the milt from the eggs. At Baird water is poured on the eggs a few moments after they become impregnated, after which they are left perfectly quiet until they separate, which, in water of the temperature of the McCloud River in September, 52° to 53°, takes about an hour. The pans, in the meanwhile, are put in a trough filled with river water to keep them from becoming too warm. After the eggs separate they are carefully washed and are carried in buckets to the hatching house, where they are measured and placed in the hatching trays.

Mr. Bower^a has the following to say as to the loss by concussion and the proper method of preventing same:

Coincident with the absorptive period in salmon eggs is an adhesive stage varying with the temperature from one to two hours, when the eggs are exceedingly sensitive. This is the so-called period of water hardening. Under no circumstances should the eggs be handled during this stage, nor should they be subjected to the slightest concussion. Repeated tests have demonstrated conclusively that even allowing the buckets containing the eggs to stand on the same platform where spawning operations are being carried on results in considerable loss.

To guard against this, the buckets should either stand on the bottom of the stream or else on a platform in every way independent of and having absolutely no connection with the main platform. To some this may seem like a small and irrelevant consideration, but strict observance is certain to reduce the loss by at least 2 or 3 per cent. During the process of water hardening the buckets should be partly submerged to properly regulate the temperature.

Due caution must be observed not to move the eggs until water hardening is complete. After a little experience the operator can readily tell, upon carefully inserting the hand and finding the eggs free and hard and no longer soft and velvety, even toward the bottom of the bucket, that they may be moved to the hatchery without fear of loss.

HATCHING APPARATUS AND METHODS.^b

The hatching apparatus generally employed on this coast is pretty much of the same pattern and is described as follows:^c

The hatching apparatus generally employed on the Pacific coast in salmon propagation consists of a combination of troughs and baskets. The troughs in common use are the so-called "Williamson troughs," which are 16 feet long, 12 or 16 inches wide, and 6½ inches deep. The troughs are arranged in pairs, and usually two or three pairs are placed end to end on different levels. The fall of water in each trough is 1½ inches. The troughs are divided by double partitions of wood or metal into compartments just enough longer than the baskets to enable the latter to be raised and lowered and to be tilted slightly. The essential feature of these troughs is that at the lower end of each compartment a partition, extending entirely across the trough, reaches from the bottom almost to the top, and another similar partition at the upper end of the compartment reaches from the top almost to the bottom of the trough, each set of partitions being about an inch apart. The water is consequently forced to flow under the upper partition and over the lower partition, and to do this it must necessarily ascend through the tray of eggs. The troughs are provided with canvas covers stretched upon light frames and made sunlight proof by saturation with asphaltum varnish, and their interiors are thickly coated with asphaltum.

The egg receptacles are wire trays or baskets about 12 inches wide, 24 inches long, and deep enough to project an inch or two above the water, which is 5 or 6 inches deep in the troughs in which they are placed. Into each of these baskets 2 gallons of salmon eggs, equivalent to about 30,000, are poured at a time. The eggs suffer no

^c Fish Culture in Alaska, by Ward T. Bower. In *Alaska Fisheries and Fur Industries in 1911*, by B. W. Evermann. U. S. Bureau of Fisheries Document No. 766, pp. 81, 82. Washington, 1912.

^b At some of the Alaska hatcheries quite large baskets, some holding as many as 103,000 red salmon eggs are used.

^c A Manual of Fish-culture, Based on the Methods of the U. S. Commission of Fish and Fisheries, revised edition, pp. 12, 13. Washington, 1900.

injury whatever from being packed together in this manner, the water being supplied in a way that forces it through the eggs, partially supporting and circulating through them. The meshes are too small to permit the eggs to pass through, although the fry are able to do so.

The advantages of this apparatus and method are:

(1) The top of the tray or basket is out of the water and always entirely dry; consequently in handling it the hands are kept dry.

(2) By tilting one end of the tray up or down a little or by lifting it entirely and settling it gently back again in its place the bad eggs will be forced to the top; thus a feather is not required in picking over the eggs and the injuries very often inflicted with it are avoided.

(3) The top of the tray being above water, the eggs can never run over the top nor escape in any way, which is a great advantage over the shallow form of tray.

(4) There is economy of space: 30,000 to 40,000 eggs can be placed in each basket, provided a sufficient quantity of water is available. Two troughs 16 feet long and 1 foot wide will by this method carry about 500,000 salmon eggs. The deep trays may be filled at least half full of eggs, and thus 10 times as many eggs can be hatched in the same space and with the same supply of water as by the old method. A good but gentle circulation is continually maintained through the eggs.

(5) The deep-tray system is admirably adapted to getting rid of mud that has collected on the eggs, for all sediment accumulating about them can be easily removed by gently moving the tray up and down a few times in the water; but if the deposit of mud on the troughs becomes so excessive as to be unmanageable, a false bottom of wire cloth or perforated zinc can be placed in the troughs at a suitable distance above their real bottom, leaving a space of about 1 or 1½ inches between the wire cloth and the trough bottom. By this means the mud that comes into the trough will sift down into the space below the wire cloth entirely out of the way of the fish, the movements of the fish themselves helping very much to produce this result. Should the accumulation of mud in the space below the false bottom of the trough become too great, it can easily be sluiced out in various ways.

When quinnat salmon eggs are simply to be matured for shipment, hatching trays with one-fourth or one-fifth inch square mesh will answer the purpose, but when the eggs are to be hatched in them, every alternate strand of wire running lengthwise, or, better still, every second and third thread, should be left out in order to form an oblong mesh through which the newly hatched fry, after separating themselves from the unhatched eggs, can escape from the hatching trays into the trough below.

At Baird eggs kept in water averaging about 54° F. hatch in 35 days. The allowance of 5 days' difference in the time of hatching for each degree of change in the water temperature is approximately correct.

For the first few days the eggs of the quinnat salmon are very hardy, and at this time they should be thoroughly picked over and the dead ones removed as far as possible before the delicate stage during the formation of the spinal column comes on, so that during that critical period they may be left in perfect quiet. As soon as the spinal column and the head show plainly, the eggs are hardy enough to ship, but when there is time enough it is better to wait a day or two until the eye-spot is distinctly visible, after which time the eggs will stand handling and may be safely shipped if properly packed.

HANDLING EGGS IN HATCHERY.^a

At some of the Bureau's stations where salmon eggs are handled it was the custom until a few years ago to "bury" the eggs or leave them undisturbed aside from picking once the day after spawning, for two or three weeks after putting them in the baskets. The result was that they were in some instances literally buried under and in such a mass of mud and sediment that many eggs were killed. Discontinuance of the practice resulted in a very appreciable improvement.

When the water is so turbid as to cause a heavy deposit of sediment, it is better to go over the eggs occasionally, even through the critical stages of development, or until the line of the fish is well formed. Of course the eggs must be handled with utmost caution at all times, but owing to their extreme sensitiveness during the two or three days following the closing of the blastopore and until a perceptible curve shows in the tail, they should be left entirely untouched. It soon becomes easy to determine the stage of an egg's development by holding it up to the light between the thumb and forefinger. In the absence of cautions and skilled operatives and unless the water is roily for an extended period, it is undoubtedly better to let the eggs

^a Fish Culture in Alaska, by Ward T. Bower. In *Alaska Fisheries and Fur Industries in 1911*. U. S. Bureau of Fisheries Document No. 766, pp. 81, 82. Washington, 1912.

remain undisturbed until the curvature of the tail is visible to the unaided eye. The accumulation of a moderate coating of sediment which readily washes off is not injurious. In a few instances it has become necessary to handle the eggs during the tender stage to arrest the spread of fungus, but where the water supply is reasonably well adapted to fish-cultural purposes such a course is rarely if ever necessary.

REMOVAL OF DEAD EGGS BY THE USE OF SALT SOLUTION.

Among the most noteworthy advances in the fish-cultural methods during the last few years has been the use of salt as an aid in the removal of dead eggs. The development of this process has extended over a period of several years, but it is more during the last year or so through the efforts of L. E. Baldrige, of the Yes Bay station, that it has reached a high degree of efficiency.

Compared with the time-honored process of picking by hand, there are marked advantages in using the salt solution, and chief among these is the great saving of labor. It is estimated that if the eggs happen to be of not more than mediocre quality it would take at least 20 pickers to remove as many dead eggs as could two men using the salt solution. Moreover, the operation is much more thoroughly performed in the latter process than is possible in picking by hand.

Another advantage of using the solution is that it is possible thoroughly to clean the eggs. This greatly reduces any loss through contamination and infection resulting from the decomposition and fungous growths which inevitably follow the long-continued presence of dead eggs that in the hand-picking method frequently escape attention. Even when utmost care is taken to pick out all dead eggs, fungoused masses will occasionally appear. This condition is rarely observed when the salt solution has been used, and it undoubtedly means that in the aggregate many eggs are saved. Still another point in favor of the solution, it is generally believed, is that it acts as a tonic or stimulant to the good eggs while at the same time as a deterrent to the growth of fungus. Again, in picking by hand there is apt to be loss by movement of the eggs during delicate stages of development; and the oft-repeated insertion of egg tweezers, which are bound to touch other eggs, undoubtedly at times results in injury.

Recent experience has demonstrated that the solution may be applied effectively to eggs freshly taken as well as those in more advanced stages of development.

The principle of the salt bath is simply that the specific gravity of the good eggs is greater than that of the bad eggs, hence upon being placed in the salt solution the good eggs sink and the bad remain afloat and are easily removed. It is vitally essential to the success of the undertaking that the solution be of the proper strength, and it is for this reason that the beginner is apt to become discouraged. If the solution is too weak all the eggs, both good and bad, will sink, while if it is too strong all will remain afloat. The margin of the proper density is so narrow that in the operation it is necessary every few minutes to strengthen the solution by adding more salt or brine, otherwise the small amount of fresh water which adheres to a basket of eggs as it is lifted from the hatching trough into the solution will affect unfavorably the results when treating succeeding baskets. Experience and careful observation, however, will soon make it possible for the operator accurately to judge when to add a bit of the stock solution. It is a convenience, of course, to have a salinometer at hand when preparing the solution. It is commonly the practice as an aid in preparing the solution to test it occasionally with a few eggs.

Highly successful results in using the solution with red salmon eggs have been attained at the Yes Bay station, and a detailed description is accordingly given of the methods pursued at that place.

The chief item of equipment consists of a water-tight wooden tank 4 feet long, 2½ feet wide, and 10 inches deep for holding the solution in which the eggs are immersed. Before each basket is immersed it is necessary that the surface of the solution be perfectly quiet, for any ripple or current will tend to disturb the buoyant effect of the solution upon the eggs. Therefore it was found of great convenience last winter to use a floating frame made of half-inch material 6 inches wide fastened together vertically and at right angles, thus forming open squares about 6 inches either way. After each basket of eggs is lifted from the salt bath this frame is placed in the solution to stop all motion of the water, being pushed down until it is almost submerged and held firmly against the side of the tank for a few seconds. Upon being carefully withdrawn the solution is quiet and the next basket of eggs may be immersed without further delay.

Another piece of equipment is a feather fan with which gently to push the floating dead eggs away from over the submerged basket into which the good eggs have settled. Unless the dead eggs are quickly moved they too will sink. A feather fan made by

fastening eagle feathers to a thin strip 8 inches long by 1½ inches wide works much more satisfactorily for this purpose than a wing. An ordinary hand scaff net about 12 by 14 inches in size for removing dead eggs from the tank, a dipper, and a bucket complete the outfit. Wood and metal surfaces in all equipment should be well coated with asphaltum or some similar preparation.

At Yes Bay as soon as five or ten million eggs are far enough advanced to stand light concussion the baskets are lifted out of the troughs and the eggs are stirred thoroughly with the hand, which causes practically all of the unfertile or empty eggs to turn white. As soon as the line of the fish shows plainly when held up to the light and there is a distinct curvature to the tail, the eggs are sufficiently well advanced in development to stand stirring. After this process the baskets are returned to the troughs and allowed to remain three days, for when first turned the unfertile eggs are about as heavy as the good eggs and consequently would sink if the salt solution were applied at once.

On the fourth day after stirring, everything being in readiness, five or six baskets are removed from a trough and set on top to drain. After a few moments a basket is grasped at each end and is lowered into the tank containing the solution until the liquid comes through the eggs. A light shake is then given to level up the eggs in the basket. Next, slowly and very gently, the basket is lowered until the brine comes almost to its rim and is held perfectly still for a moment. All the eggs in the basket will rise, but soon the good eggs will begin to sink, and presently, if it is a basket of poor eggs, the surface will be completely covered with bad eggs. Now, without the slightest jar, the basket is lowered far enough below the surface to permit an egg to float over the rim. The bad eggs will immediately start toward the edges of the tank. After a few seconds the basket is gently lowered until it rests upon the bottom. The remaining dead eggs are then brushed away from over the basket by means of quick, short, and light strokes of the feather fan, long, sweeping strokes are to be carefully avoided. One end of the basket is then gently raised until it is above the surface of the brine and the basket is drawn toward the end of the tank and out from under the floating dead eggs. At the same time the fan is used with the other hand to aid in moving any of these floating eggs to one side. The fan is then dropped and the lower end of the basket is grasped and the whole is quickly raised out of the solution. The basket is set at an angle on the tank for a moment to drain and is then carried to the hatching trough. The attendant lifts out another basket to drain along with the four or five others originally removed and returns to the tank of brine with the basket that has been draining the longest.

While this is being done the other operator skims the dead eggs off the surface of the brine and places the frame described above in the tank for a moment to stop all motion of the solution. After five or six baskets have been treated, any eggs that have settled to the bottom of the tank are removed, as they absorb and weaken the brine. It is necessary, as earlier mentioned, to add a little fresh brine after handling each basket. The eggs should be as clean as possible, as the solution will not be effective when it contains much sediment. A 1-inch hole with plug in one corner of the tank is convenient for drawing off any deposit of this character. Should failure occur in treating a basket of eggs, as, for example, if by sudden jar they are all caused to sink, or if the brine is too weak or too strong, the basket must be put back in the hatching trough, as it will not respond to treatment again the same day.

At Yes Bay last winter a large portion of the 72,000,000 eggs were thoroughly cleaned up at one handling. Two men ran as many as 10,000,000 eggs through the salt bath in a single day. It is customary on the day after treating the eggs to have them gone over so that if any dead eggs remain they may be picked out by hand. This, however, requires very little time, as but few dead eggs are found. No alarm need be felt if the eggs seem to shrink as a result of the immersion, for they will soon resume their normal size upon being replaced in fresh water.

The use of the salt solution has been extended lately to the handling of lake trout eggs in Michigan and Minnesota, and there appears to be no reason why it is not equally well adapted to the eggs of other salmonoids. Certainly its many advantages commend further experimentation in this direction.

The eggs of the salmon hatch very gradually at first, only a small proportion coming out the first day, but the number increases daily until the climax is reached, when large numbers of young burst their shells in a single day. As at this time the vast number of discarded shells are apt to clog up the guard screens at the outlets of the troughs, great care and vigilance is necessary to prevent this by thoroughly cleansing them frequently.

The hatched fish easily slip through the oblong mesh in the bottom of the trays into the space below. They should be assisted in doing this by gently raising and lowering the tray at intervals, care being taken not to raise them out of the water.

After they are all hatched out and in the bottom of the troughs, about the only danger to guard against is that of suffocation. They frequently crowd together in heaps and dig down under one another until some of them die for want of running water, which is less than an inch away from them. The best remedy is to thin them out.

John Pease Babcock, Assistant to the Commissioner of Fisheries of the Province of British Columbia, in 1910 advanced a novel suggestion that freshly fertilized eggs buried immediately under sand and gravel would produce strong healthy fry at less cost than under existing hatching methods, and that fry so produced are stronger and more capable of resisting the attacks of their active enemies. The interesting account of his experiments is reproduced entire.^a

In writing of the propagation of salmon and trout, some authorities state that considerable loss is occasioned in natural propagation by many of the eggs becoming embedded in sand and gravel; that all the eggs so embedded are lost.

Observation and experiment in the propagation of Pacific salmon and trout for a considerable period lead me to advance the theory that in natural propagation only those eggs which become embedded beneath several inches of sand and gravel produce alevins which live to attain the fry stage; and that those eggs which are not covered by several inches of sand and gravel are either consumed by active aquatic enemies or destroyed by vegetable molds, commonly termed "fungus."

My experiments have demonstrated that the burial of freshly fertilized eggs of the *nerka* and other Pacific salmon does not smother them; that eggs so treated not only live but hatch; and that if they are covered to a sufficient depth the alevins produced survive and possess the instinct and power to work their way gradually to the surface; that if buried beneath 5 or 6 inches of sand and gravel such eggs will hatch, and the young will work their way up through the sand and gravel to the surface, and that by the time they emerge, have absorbed their sacs and are then exempt from the attacks of vegetable molds.

Eggs buried under 1 or 2 inches of sand and gravel produce alevins that work their way up to the surface before the sac is absorbed, and upon reaching the surface are subject to attack by vegetable molds, and a very large percentage are thus destroyed, as well as by the more developed forms of aquatic life.

Eggs buried to a depth of 3 inches produce alevins that work their way to the surface so gradually that by the time they reach the surface their sacs are so nearly absorbed that many, but not all, resist the effects of fungus. Alevins from eggs buried beneath less than 4 inches of sand are liable to reach the surface while the sac is so thinly covered that few, if any, survive the effects of fungous growth.

The spawning beds of Pacific coast streams from California to Alaska (to which my observations have been confined), where the salmon spawn in numbers are, during and after the spawning period, covered with more or less vegetable molds. These molds are particularly common in the beds of streams where great numbers of salmon have spawned and died. Every experienced fish culturist knows that most waters carry great numbers of spores of fungi, and how difficult it is to prevent eggs and alevins from being attacked and injured by their growth. I believe that in natural propagation fungous growths destroy more salmon eggs and alevins than all other causes combined. The vegetable molds of Pacific streams are not active beneath the surface of the beds of streams. Salmon eggs cast therein, if even thinly covered with sand, are not injured by them. These molds do not affect the fry that have nearly or entirely absorbed their sacs, but they are deadly if permitted to attach themselves to either the eggs or the alevins.

^a Some Experiments in the Burial of Salmon Eggs—Suggesting a New Method of Hatching Salmon and Trout. By John Pease Babcock. Transactions, American Fisheries Society, 1910, pp. 393-395. Washington, 1911.

This method has been carried out on a considerable scale by A. Robertson, a Dominion of Canada hatchery superintendent located on the Fraser River, and the results published in "Hatching Salmon Fry in Gravel," *Pacific Fisherman*, Seattle, Wash., Vol. 17, No. 6, June, 1919, p. 38, illus.

My experiments along this line lead me to express the opinion that by the burial of freshly fertilized salmon eggs under 6 or 7 inches of sand and gravel strong healthy fry can be produced at less cost than under existing hatching methods, and that fry so produced are stronger and more capable of resisting the attacks of their active enemies.

I trust that this short statement of my experiments in the burial of salmon eggs may be deemed of sufficient economic importance to stimulate fish culturists generally in experimenting along similar lines. Those who do will perhaps experience some difficulty at first in the covering of a large number of eggs. Experimenters will find that after preparing suitable beds of sand and small gravel the eggs can be evenly laid and held until covered, if the surface of the bed is first thickly indented with cells a little deeper than the eggs. This can be readily accomplished by stamping the bed with a board covered with projections or pegs of suitable size.

My experiments suggest that in the near future most of the buildings and hatching apparatus now used in the propagation of salmon and trout will be dispensed with; that after the eggs have been expressed and fertilized, instead of being placed in wire baskets in hatcheries, they will be buried beneath the sand and gravel of the beds of natural or prepared streams, and that with the exception of watchmen to protect them, little or no other labor will be required.

FEEDING AND PLANTING THE FRY.

For some time the fry remain at the bottom of the trough, but when the yolk sac is nearly absorbed they rise from the bottom and begin swimming. As a rule the fry are planted about the time the yolk sac is absorbed, thus obviating the necessity for feeding them. Some experts advise planting young red salmon when the umbilical sac is about two-thirds absorbed, which is the time when the fish begin to swim up freely. With the temperatures prevailing at the Alaska hatcheries, this means that the fry must be held at least four or five weeks after hatching.

PACKING EGGS FOR SHIPMENT.

In packing salmon eggs for shipment it is the custom at the Bureau of Fisheries' hatcheries to use a packing box made of one-half inch pine, 2 feet square and 1 foot deep.^a

At the bottom is placed a thick layer of moss, then a layer of mosquito netting, then a layer of eggs, then mosquito netting again, then successive layers of moss, netting, eggs, netting, and so on to the middle of the box. Here a firm wooden partition is fastened in and the packing renewed above in the same manner as below. The cover is then laid on the top, and when two boxes are ready they are placed in a wooden crate, made large enough to allow a space of 3 inches on all sides of the boxes. This space is filled with hay to protect the eggs against changes of temperature, and, the cover being put on the eggs, they are ready to ship. In the middle of the crate an open space about 4 inches in depth is left, between the two boxes of eggs, for ice. As soon as the crates arrive at the railway station this space, as well as the top of the crate is filled in with ice. Recent experiments show that salmon eggs can be packed and safely transported to considerable distances when they are first taken.

REARING SALMON FRY.

For many years it was the custom to plant the fry as soon as they had absorbed the yolk sac, a period of about 30 days. A few thousands were sometimes raised to the fingerling, yearling, or adult stage, more as a curiosity than anything else. No particular difficulty was experienced in raising these fish, but the expense entailed in feeding them for a prolonged period, and the impossibility of doing so unless large ponds were constructed at great expense for the pur-

^a A Manual of Fish-culture, Based on the Methods of the United States Commission of Fish and Fisheries, revised edition, p. 14. Washington, 1917.

pose of holding them during the feeding period, prevented the general adoption of the rearing system.

For some years certain fish culturists and others had contended that the planting of fry just after they had absorbed the umbilical sac was an economic mistake, claiming that at this age they were weak and comparatively sluggish in their movements, and would fall easy prey to their numerous fish, bird, and other enemies. The late Robert D. Hume, who built and operated a hatchery on the lower Rogue River, also one on the upper Rogue River, which the United States Bureau of Fisheries operated for some years, was one of the first to take up the rearing of salmon fry on any scale.

In time these objections bore weight, and a few years ago the construction of ponds in which fry could be held and fed until they had reached a size which would insure them at least an even chance for their lives was undertaken all along the coast except in British Columbia, with the result that to-day there is a pond capacity for about one-half of the total capacity of the various hatcheries.

Most of the nursery ponds have been constructed near the hatcheries and usually comprise oblong trenches dug in the earth and walled with cement and stone.

In Oregon the State authorities found that the best results in pond rearing were obtained by using creek or natural ponds, which were made by placing dams across the small streams in the vicinity of the hatcheries. When first taken from the hatching troughs the fry are placed in the artificial ponds until the danger from spring freshets in the small streams is over. They are then transferred to the natural ponds, where the continual flow of fresh water, and the logs, rocks, etc., which provide shade and shelter, afford more natural conditions, and in which the natural food of the fry supplements the artificial food provided by man.

A big advantage in connection with the use of natural ponds is the comparatively small expense involved in providing for them as compared with the large expense involved in the construction of cement ponds.

The young fry show when they are ready to feed by darting to one side or the other when small particles of food are dropped in the water and float past them. For the first few weeks they should be fed regularly and as often as six times a day, and the earlier in the day the feeding begins and the later it continues at night the better. Two hours after feeding they will be found to be ravenously hungry, and as they grow much faster for frequent feeding great care should be taken to see that they are well fed. If not fed sufficiently they will bite at one another and cause more or less mortality among themselves.

FOOD.

In feeding salmon fry almost every conceivable food has been utilized. By universal consent liver is conceded to be the best food for the fry, as it can be ground finer than other foods and the blood which it contains is highly nutritious. At many places, however, it is impossible to secure liver, while its cost when available is generally prohibitive.

The food used is generally that most available and which experience has shown that the fry like and upon which they thrive.

In Oregon ^a it has been found that the extremely young fry thrived on a mixture of ground dried salmon and mush (composed of middlings and other wheat products). Milk curds from near-by creameries also proved satisfactory. The older fish are fed on ground smelt, lampreys, spent salmon, both dried and salted, and offal from the canneries, some loose and some packed in 1-gallon cans. An excellent food is broken-up ice-cream cones. This latter food also has the advantage of not sinking to the bottom and thus polluting the water; and because it floats at the surface the surplus can be lifted out with a dip net.

SALMON SOLD AFTER STRIPPING.

For many years it was the custom after the eggs had been stripped from the salmon to either give the carcasses to the Indians or to bury them. In 1917, under stress of the great demand for fish caused by the war, L. H. Darwin, fish and game commissioner of Washington, after an analysis by chemists had shown that the flesh was wholesome food, offered for sale, at a low rate, these spawned-out fish. The offer was accepted by several of the cities of the State, some of which established municipal markets at which these salmon, as well as other food products, were offered for sale at prices ruling lower than those in the commercial markets. It is probable that the economic utilization of these salmon will be permanent, and will prove a source of considerable profit to the States which sell them.

SALMON HATCHERIES ON THE PACIFIC COAST.

Below is shown a list of the salmon and steelhead-trout hatcheries operated on the Pacific coast during the year 1919:

U. S. BUREAU OF FISHERIES.

Alaska:

Afognak.
Yes Bay.

California:

Baird.
Battle Creek.
Hornbrook.
Mill Creek

Oregon:

Clackamas.
Applegate.
Snake River.
Rogue River.
Upper Clackamas.

Washington:

Baker Lake.
Birdsview.
Brinnon.
Darrington.
Duckabush.
Illabott Creek.
Quilcene.
Big White Salmon.
Little White Salmon.

STATE OF CALIFORNIA.

Sisson.
Brookdale.
Price Creek.
Ukiah.

STATE OF OREGON.

Wallowa River.
McKenzie River.
Salmon River.
Bonneville.
Santiam River (eyeing station).
Klaskanine.
Willamette River (eyeing station).
Eagle Creek.
Snake River (Idaho).
Tillamook.
Yaquina.
Siuslaw.
Umpqua.
South Coos.
Coquille.
Alsea.
Rogue River.

^a Rearing and Feeding Salmon Fry in Oregon. By R. E. Clanton. Transactions, Pacific Fisheries Society, 1914, p. 91-94. Seattle, 1915.

STATE OF WASHINGTON.

Chambers Creek.
 Chehalis.
 Chehalis No. 2.
 Chinook.
 Dungeness.
 Ellwah.
 Green River.
 Green River No. 2.
 Nasel River.
 Nisqually.
 Nooksack.
 Nooksack River, Middle Fork.
 Nooksack River, South Fork.
 North River.
 Pilchuck.
 Puyallup River.
 Samish.
 Skagit River.
 Skokomish.
 Skykomish.
 Snohomish.
 Stillaguamish.
 Kalama.
 Lewis River.
 Pateros-Methow.
 Tahuya (eyeing station).
 Wenatchee.
 Tilton River.
 Wind River.
 Humptulips.
 Willapa.
 Willapa No. 2.

DOMINION OF CANADA.

Granite Creek.
 Pemberton.
 Harrison Lake.
 Stuart Lake.
 Skeena River.
 Babine Lake.
 Rivers Inlet.
 Fraser River.
 Anderson Lake.
 Kennedy Lake.
 Cowichan Lake.

PROVINCE OF BRITISH COLUMBIA.

Seton Lake.

BRITISH COLUMBIA PACKERS ASSOCIATION.

Nimkish Lake.

ALASKA (PRIVATE HATCHERIES).

Alaska Packers Association:
 Fortmann.
 Northwestern Fisheries Co.:
 Quadra.
 Hetta.
 North Pacific Trading & Packing Co.:
 Klawak.

GENERAL STATISTICS.

Distribution of fry, etc.—In the next table is shown by years and species the distribution in Pacific coast waters of fry, fingerlings, yearlings, and adults from 1873, when the first hatchery began operation, to 1919, inclusive. The figures on fingerlings, yearlings, and adults are not as complete as could be wished, this being due to certain of the State fish commissions not separating them from the fry in the published results.

The table shows the enormous total of 7,990,416,264 fry and 275,093,097 fingerlings, yearlings, and adults as having been deposited in local waters since the inception of the work on this coast. Of these nearly one-half were sockeye, or red salmon, followed by chinook, or spring, coho, or silver, dog, steelhead trout, and humpback salmon in the order named.

This table does not show the large number of eggs, fry, etc., shipped from the coast hatcheries to other sections of the country and to various foreign countries. These appear in the tables shown under the various States, Provinces, and Territories.



FIG. 43.—UNITED STATES SALMON HATCHERY, YES BAY, ALASKA.



FIG. 44.—UNITED STATES SALMON HATCHERY, AFOGNAK, ALASKA.



FIG. 45.—ALASKA PACKERS ASSOCIATION FORTMANN HATCHERY, NAHA STREAM, ALASKA; THE LARGEST HATCHERY IN THE WORLD.

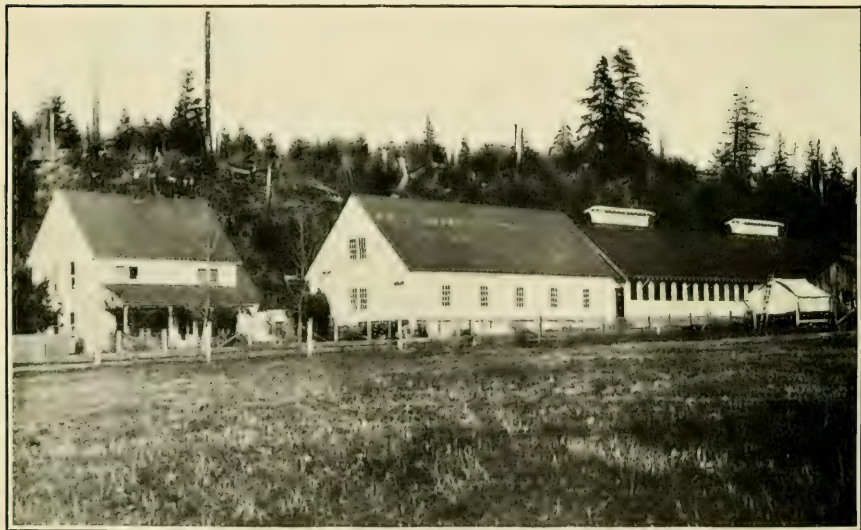


FIG. 46.—CHEHALIS HATCHERY, WASHINGTON FISH AND GAME COMMISSION, SATSOP, WASH.

DISTRIBUTION OF SALMON IN THE PACIFIC COASTAL STREAMS OF NORTH AMERICA, IN SPECIFIED YEARS.

| Year. | Chinook, king, or spring. | | Coho, or silver. | | Chum. | | Humpback, or pink. | |
|--------|---------------------------|---|------------------|---|-------------|---|--------------------|---|
| | Fry. | Finger- lings, yearlings, and adults. | Fry. | Finger- lings, yearlings, and adults. | Fry. | Finger- lings, yearlings, and adults. | Fry. | Finger- lings, yearlings, and adults. |
| 1873. | 520,000 | | | | | | | |
| 1874. | 850,000 | | | | | | | |
| 1875. | 2,230,600 | | | | | | | |
| 1876. | 2,000,000 | | | | | | | |
| 1877. | 2,550,000 | | | | | | | |
| 1878. | 2,532,620 | | | | | | | |
| 1879. | 5,376,560 | | | | | | | |
| 1880. | 4,059,200 | | | | | | | |
| 1881. | 4,974,790 | | | | | | | |
| 1882. | 3,991,750 | | | | | | | |
| 1883. | 660,000 | | | | | | | |
| 1886. | 150,000 | | | | | | | |
| 1887. | 200,000 | | | | | | | |
| 1888. | 2,590,660 | | | | | | | |
| 1889. | 8,168,000 | | | | | | | |
| 1890. | 5,250,475 | | | | | | | |
| 1891. | 9,269,000 | | | | | | | |
| 1892. | 4,250,000 | 25,000 | | | | | | |
| 1893. | 10,825,950 | | | | | | | |
| 1894. | 8,427,900 | | 281,000 | | | | | |
| 1895. | 6,458,000 | | 910,000 | 560,000 | | | | |
| 1896. | 25,581,033 | 897,150 | | | | | | |
| 1897. | 31,146,095 | | 298,137 | | | | | |
| 1898. | 73,684,076 | | | | | | | |
| 1899. | 56,773,351 | | 189,000 | | | | | |
| 1900. | 34,974,064 | | 13,925,104 | | 10,301,760 | | | |
| 1901. | 36,593,138 | 1,668 | 20,047,935 | | 16,478,280 | | | |
| 1902. | 73,882,120 | | 41,436,123 | | 9,937,390 | | | |
| 1903. | 75,538,384 | | 34,460,291 | | 10,012,390 | | | |
| 1904. | 161,530,963 | | 23,894,026 | | | 521,797 | | |
| 1905. | 143,714,117 | | 30,743,492 | | | | | |
| 1906. | 167,745,494 | 122,980 | 47,350,449 | 300 | 3,268,800 | | 969,990 | |
| 1907. | 124,578,390 | | 44,426,380 | | 6,120,000 | | 4,221,255 | |
| 1908. | 135,447,179 | 2,165,797 | 54,108,557 | | 4,342,350 | | 31,920,662 | |
| 1909. | 88,188,707 | 16,949 | 50,648,674 | | 7,805,000 | | 10,000 | |
| 1910. | 97,361,532 | 225 | 45,863,952 | | 8,607,500 | | 2,251,340 | |
| 1911. | 80,570,265 | 11,700 | 52,869,759 | | 13,435,750 | | 460,150 | |
| 1912. | 101,810,515 | 1,405,860 | 66,087,446 | 116,300 | 4,684,950 | | 34,205,460 | |
| 1913. | 112,008,886 | | 79,313,839 | | 35,792,440 | | 1,888 | |
| 1914. | 133,271,477 | 2,571,711 | 67,682,576 | | 16,623,984 | | 39,685,814 | |
| 1915. | 149,666,221 | 9,875,745 | 92,926,831 | | 63,088,372 | | 7,867,484 | |
| 1916. | 151,649,595 | 26,070,128 | 56,647,147 | 5,543,712 | 63,390,768 | 1,000,000 | 15,842,627 | 2,915,000 |
| 1917. | 96,975,725 | 27,060,581 | 17,828,235 | 4,663,560 | 26,133,925 | 7,014,580 | 4,953,000 | 7,449,030 |
| 1918. | 133,192,069 | 22,384,610 | 55,667,111 | 10,148,815 | 82,020,140 | | 22,159,186 | 4,736,000 |
| 1919. | 67,908,011 | 58,007,670 | 32,307,426 | 3,286,580 | 26,772,025 | 4,524,560 | 5,426,000 | 369,958 |
| Total. | 2,428,054,687 | 150,527,774 | 929,845,490 | 24,319,267 | 408,815,854 | 12,539,140 | 170,499,653 | 15,469,988 |

DISTRIBUTION OF SALMON IN THE PACIFIC COASTAL STREAMS OF NORTH AMERICA, IN SPECIFIED YEARS—Continued.

| Year. | Sockeye, red, or blueback. | | Steelhead trout. | | Total. | |
|------------|----------------------------|-------------------------------------|------------------|-------------------------------------|---------------|-------------------------------------|
| | Fry. | Fingerlings, yearlings, and adults. | Fry. | Fingerlings, yearlings, and adults. | Fry. | Fingerlings, yearlings, and adults. |
| 1873..... | | | | | 520,000 | |
| 1874..... | | | | | 850,000 | |
| 1875..... | | | | | 2,250,000 | |
| 1876..... | | | | | 2,000,000 | |
| 1877..... | | | | | 2,550,000 | |
| 1878..... | | | | | 2,582,620 | |
| 1879..... | | | | | 5,376,500 | |
| 1880..... | | | | | 4,059,290 | |
| 1881..... | | | | | 4,974,790 | |
| 1882..... | | | | | 3,991,750 | |
| 1884..... | | | | | 600,000 | |
| 1885..... | 1,800,000 | | | | 1,800,000 | |
| 1886..... | 2,625,000 | | | | 2,775,000 | |
| 1887..... | 4,414,000 | | | | 4,614,000 | |
| 1888..... | 5,807,000 | | | | 8,397,000 | |
| 1889..... | 4,419,000 | | | | 12,587,000 | |
| 1890..... | 6,640,000 | | | | 11,890,475 | |
| 1891..... | 3,603,800 | | | | 12,872,800 | |
| 1892..... | 6,000,000 | | | | 10,299,000 | 25,000 |
| 1893..... | 6,274,000 | | | | 17,099,950 | |
| 1894..... | 8,504,000 | | 353,500 | | 17,565,400 | |
| 1895..... | 11,681,000 | | | | 19,049,000 | 560,000 |
| 1896..... | 15,868,000 | | 107,808 | | 41,556,841 | 807,150 |
| 1897..... | 18,374,440 | | 262,000 | | 50,080,672 | |
| 1898..... | 20,916,000 | | 650,000 | | 95,250,076 | |
| 1899..... | 15,761,000 | | 8,625 | | 72,731,976 | |
| 1900..... | 29,590,000 | | 2,061,560 | | 89,852,488 | |
| 1901..... | 19,901,253 | | 1,709,326 | | 94,699,932 | 1,668 |
| 1902..... | 72,679,000 | | 3,243,948 | | 201,145,581 | |
| 1903..... | 89,398,789 | | 4,509,641 | 37,033 | 213,939,500 | 37,033 |
| 1904..... | 70,710,200 | | 4,207,920 | | 260,864,906 | |
| 1905..... | 119,963,200 | | 3,805,675 | | 298,226,484 | |
| 1906..... | 232,037,442 | | 6,725,965 | 24,383 | 458,104,140 | 147,663 |
| 1907..... | 228,018,450 | | 5,629,493 | | 412,996,968 | |
| 1908..... | 230,528,455 | | 5,837,671 | | 462,184,874 | 2,165,797 |
| 1909..... | 239,251,146 | | 8,193,778 | | 394,097,305 | 16,949 |
| 1910..... | 396,215,795 | | 11,368,446 | | 561,668,565 | 225 |
| 1911..... | 257,463,497 | | 14,995,717 | | 419,795,138 | 11,700 |
| 1912..... | 324,325,768 | | 12,710,382 | 177,790 | 543,824,521 | 1,699,950 |
| 1913..... | 242,146,069 | | 16,654,906 | | 485,918,028 | |
| 1914..... | 261,365,781 | | 11,719,558 | | 530,349,190 | 2,571,711 |
| 1915..... | 198,910,010 | 8,369,830 | 22,942,900 | | 535,401,818 | 18,245,575 |
| 1916..... | 256,582,879 | 15,292,732 | 18,952,136 | 3,480,092 | 563,065,182 | 54,301,664 |
| 1917..... | 215,853,504 | 12,305,953 | 15,241,720 | 1,887,950 | 376,986,109 | 60,381,654 |
| 1918..... | 155,043,461 | 12,705,285 | 18,480,440 | 3,520,420 | 466,502,407 | 53,495,130 |
| 1919..... | 62,397,320 | 14,299,960 | 17,755,206 | 135,500 | 212,465,988 | 80,624,228 |
| Total..... | 3,835,069,259 | 62,973,760 | 208,128,321 | 9,263,168 | 7,990,416,264 | 275,093,097 |

Output of United States Bureau of Fisheries hatcheries.—The next table shows by years and species the combined output of the various hatcheries of the United States Bureau of Fisheries on this coast. The greater part of the egg output was to various State hatcheries on the Pacific coast, more particularly those belonging to the State of California. The total figures show that since the Bureau began operations on this coast it has distributed 1,173,825,343 eggs, 2,063,076,832 fry, and 281,317,294 fingerlings, yearlings, and adults.

OUTPUT OF PACIFIC COAST SALMON HATCHERIES OWNED BY THE U. S. BUREAU OF FISHERIES, 1872 TO 1919.

| Year. | Chinook, king, or spring. | | | Coho, or silver. | | |
|------------|---------------------------|-------------|---|------------------|-------------|---|
| | Eggs. | Fry. | Finger- lings, yearlings, and adults. | Eggs. | Fry. | Finger- lings, yearlings, and adults. |
| 1872. | 30,000 | | | | | |
| 1873. | 1,400,000 | | | | | |
| 1874. | 4,155,000 | 850,000 | | | | |
| 1875. | 6,250,000 | 1,750,000 | | | | |
| 1876. | 5,065,000 | 1,500,000 | | | | |
| 1877. | 4,983,000 | 2,000,000 | | | | |
| 1878. | 7,810,000 | 2,500,000 | | | | |
| 1879. | 4,250,000 | 2,300,000 | | | | |
| 1880. | 3,800,000 | 2,000,000 | | | | |
| 1881. | 4,300,000 | 3,100,000 | | | | |
| 1882. | | 3,991,750 | | | | |
| 1883. | | 776,125 | | | | |
| 1884. | 3,450,000 | 6,000,000 | | | | |
| 1885. | 2,554,000 | 2,860,475 | | | | |
| 1886. | 3,688,000 | 5,678,525 | | | | |
| 1887. | 2,902,000 | 1,647,900 | | | | |
| 1888. | 3,530,000 | 5,290,100 | | | | |
| 1889. | 7,500,000 | 651,500 | | | 280,000 | |
| 1890. | 3,699,000 | 500,000 | | | 690,000 | 560,000 |
| 1891. | 2,798,500 | 3,547,850 | | | | |
| 1892. | 18,232,590 | 9,828,095 | 557,150 | | 298,137 | |
| 1893. | 30,605,000 | 39,950,698 | | | | |
| 1894. | 32,618,000 | 9,366,366 | | | | |
| 1895. | 7,411,000 | 14,287,264 | | | | |
| 1896. | 11,615,036 | 7,987,107 | 1,668 | | | |
| 1897. | 19,446,410 | 29,340,308 | | | | |
| 1898. | 16,160,177 | 23,845,956 | 250 | 680,800 | | |
| 1899. | 75,217,354 | 35,006,988 | | | 3,984,645 | |
| 1900. | 99,055,765 | 21,620,292 | | 107,000 | 9,321,513 | |
| 1901. | 115,648,145 | 20,797,543 | 123,118 | 239,180 | 6,445,574 | 300 |
| 1902. | 78,587,705 | 17,567,092 | | 760,000 | 3,636,952 | |
| 1903. | 68,520,550 | 24,998,185 | 2,165,797 | 296,000 | 13,420,714 | 57,932 |
| 1904. | 38,859,265 | 20,177,286 | 16,949 | 272,000 | 9,470,925 | |
| 1905. | 38,306,769 | 15,682,064 | 225 | 275,000 | 10,888,025 | |
| 1906. | 37,314,514 | 16,659,684 | 211,700 | 2,391,900 | 6,210,296 | |
| 1907. | 56,837,550 | 31,040,803 | 1,405,860 | 52,000 | 12,955,824 | |
| 1908. | 58,296,873 | 33,413,423 | | 202,000 | 13,952,963 | |
| 1909. | 31,032,645 | 48,895,607 | 5,582,796 | 95,840 | 24,619,456 | 27,258 |
| 1910. | 25,751,005 | 53,612,056 | 9,604,985 | 111,200 | 24,018,355 | 267,662 |
| 1911. | 20,622,340 | 57,870,714 | 22,982,655 | 198,500 | 8,124,334 | 1,469,507 |
| 1912. | 7,191,200 | 16,404,404 | 27,858,026 | | 4,403,700 | 4,662,960 |
| 1913. | 18,074,900 | 6,028,918 | 63,176,244 | | 980,300 | 10,504,115 |
| 1914. | 12,782,500 | 389,002 | 34,688,150 | | 7,544,020 | 1,291,730 |
| Total..... | 967,351,733 | 601,720,170 | 167,775,573 | 5,681,420 | 162,200,940 | 18,841,464 |

| Year. | Chum. | | Humpback, or pink. | | Sockeye, red, or blueback. | | |
|--------|-------------|---|--------------------|------------|----------------------------|-------------|---|
| | Fry. | Finger- lings, yearlings, and adults. | Eggs. | Fry. | Eggs. | Fry. | Finger- lings, yearlings, and adults. |
| 1900. | | | | | | 10,683,000 | |
| 1901. | | | | | | 3,834,453 | |
| 1902. | | | | | | 3,371,000 | |
| 1903. | | | | | | 3,791,789 | |
| 1904. | | | | 176,597 | | 3,855,000 | |
| 1905. | | | | | | 7,819,281 | 10,000 |
| 1906. | | 2,000 | 960,990 | | 880,000 | 9,923,680 | 9,500 |
| 1907. | | | 502,000 | | | 58,835,055 | |
| 1908. | | | | 6,764,762 | 75,000 | 69,883,305 | |
| 1909. | | | | 10,000 | 100,000 | 93,408,496 | |
| 1910. | | | | 1,731,740 | | 146,081,595 | |
| 1911. | 911,650 | | 100,000 | 460,150 | | 100,990,000 | |
| 1912. | 2,465,060 | | 3,271,740 | 2,566,325 | 2,000,000 | 91,422,273 | |
| 1913. | 19,479,000 | | | 1,880 | 2,000,000 | 78,724,900 | |
| 1914. | 8,672,735 | | 13,260,000 | 37,648,422 | 6,020,000 | 53,071,574 | 120,000 |
| 1915. | 35,504,707 | | 14,500,000 | 7,153,500 | 155,000 | 46,282,691 | 8,116,405 |
| 1916. | 21,500,944 | 1,060,660 | 7,090,000 | 6,166,460 | 2,915,000 | 90,988,566 | 2,666,308 |
| 1917. | 14,463,360 | 7,014,580 | | 165,000 | 2,000,000 | 84,152,825 | 2,115,953 |
| 1918. | 9,892,115 | | | 2,132,831 | 3,736,000 | 67,591,200 | 12,705,285 |
| 1919. | 4,544,000 | 4,524,560 | 10,662,000 | 5,426,500 | 369,558 | 48,393,000 | 25,950,000 |
| Total. | 117,402,481 | 12,339,140 | 48,697,740 | 71,314,097 | 14,643,823 | 136,311,060 | 1,072,544,583 |

a Operations suspended from 1884 to 1888, both inclusive.

OUTPUT OF PACIFIC COAST SALMON HATCHERIES OWNED BY THE U. S. BUREAU OF FISHERIES, 1872 TO 1919—Continued.

| Year. | Steelhead trout. | | | Total. | | |
|-------------|------------------|------------|-------------------------------------|---------------|---------------|-------------------------------------|
| | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
| 1872..... | | | | 30,000 | | |
| 1873..... | | | | 1,400,000 | | |
| 1874..... | | | | 4,155,000 | 850,000 | |
| 1875..... | | | | 6,250,000 | 1,750,000 | |
| 1876..... | | | | 5,065,000 | 1,500,000 | |
| 1877..... | | | | 4,983,000 | 2,000,000 | |
| 1878..... | | | | 7,810,000 | 2,500,000 | |
| 1879..... | | | | 4,250,000 | 2,300,000 | |
| 1880..... | | | | 3,800,000 | 2,000,000 | |
| 1881..... | | | | 4,300,000 | 3,100,000 | |
| 1882..... | | | | | 3,991,750 | |
| 1883..... | | | | | 776,125 | |
| 1889 a..... | | | | 3,450,000 | 6,000,000 | |
| 1890..... | | | | 2,554,000 | 2,860,475 | |
| 1891..... | | | | 3,688,000 | 5,678,525 | |
| 1892..... | | | | 2,902,000 | 1,647,900 | |
| 1893..... | | | | 3,530,000 | 5,290,100 | |
| 1894..... | 75,000 | 308,500 | | 7,575,000 | 1,240,000 | |
| 1895..... | | 852,500 | 332,000 | 3,699,000 | 2,042,500 | 892,000 |
| 1896..... | 175,000 | 107,808 | | 2,973,500 | 3,655,658 | 557,150 |
| 1897..... | 50,000 | 257,000 | | 18,282,590 | 10,383,232 | |
| 1898..... | 60,000 | 650,000 | | 30,665,000 | 40,600,698 | |
| 1899..... | 159,000 | 12,125 | | 32,777,000 | 9,378,491 | |
| 1900..... | 415,000 | 125,000 | | 7,826,000 | 25,242,088 | |
| 1901..... | 246,000 | 65,850 | 25,000 | 11,861,036 | 12,189,451 | 26,668 |
| 1902..... | 481,000 | 130,250 | | 19,927,410 | 33,266,088 | |
| 1903..... | 480,000 | 702,700 | 285,848 | 17,320,977 | 28,362,257 | 286,098 |
| 1904..... | 225,000 | 93,205 | 11,090 | 75,442,354 | 43,116,435 | 11,090 |
| 1905..... | 464,400 | 537,205 | | 96,627,165 | 39,298,291 | 10,000 |
| 1906..... | 358,000 | 1,834,485 | 40,383 | 117,127,325 | 39,971,272 | 173,301 |
| 1907..... | 250,000 | 1,190,305 | | 79,597,705 | 81,229,404 | |
| 1908..... | 487,725 | 1,089,596 | | 69,881,275 | 116,156,562 | 2,223,729 |
| 1909..... | 483,725 | 1,670,371 | | 39,714,990 | 124,737,078 | 16,949 |
| 1910..... | 300,000 | 3,511,226 | | 38,881,709 | 177,894,650 | 225 |
| 1911..... | 660,000 | 3,826,439 | | 40,466,414 | 128,559,119 | 211,700 |
| 1912..... | 905,000 | 4,289,415 | 294,090 | 43,066,290 | 144,769,730 | 1,699,950 |
| 1913..... | 1,330,000 | 4,272,225 | | 61,828,873 | 149,850,391 | |
| 1914..... | 729,000 | 4,022,438 | | 51,137,485 | 176,930,232 | 5,734,409 |
| 1915..... | 877,000 | 5,262,973 | 1,048,317 | 41,394,205 | 171,834,282 | 19,456,849 |
| 1916..... | 1,490,000 | 841,600 | 3,676,805 | 32,410,840 | 185,432,558 | 34,710,275 |
| 1917..... | 3,237,600 | 2,013,510 | 1,891,450 | 12,428,800 | 121,642,739 | 51,071,999 |
| 1918..... | 1,070,000 | 103,000 | 6,854,785 | 37,144,900 | 86,723,394 | 96,976,429 |
| 1919..... | 775,000 | | 1,148,000 | 125,600,500 | 66,296,522 | 67,382,358 |
| Total..... | 15,783,450 | 37,769,726 | 15,607,768 | 1,173,825,343 | 2,062,952,997 | 281,441,179 |

a Operations suspended from 1884 to 1888, both inclusive.

ACCLIMATIZING PACIFIC SALMON IN OTHER WATERS.

For many years efforts have been made by the United States Bureau of Fisheries and various State fish commissions to introduce Pacific coast salmon in eastern waters. In the early history of fish culture chinook fry were planted in almost every imaginable stream along the Atlantic seaboard, in various streams in the Mississippi Valley, and also in tributaries of the Great Lakes. In most cases, owing to the unsuitability of the water, the experiment was doomed to failure from the start. In the case of a few streams where results might have been obtained, the plantings were at long intervals and the fish were too small to protect themselves, while no effort was made by the State authorities to protect them.

The most successful results with plants of chinook salmon have been obtained in Lake Sunapee, N. H., where it is now a not uncommon thing for anglers to catch chinook with rod and reel.

In 1912 about 10,000 chinook fingerlings from Columbia River eggs furnished by the United States Bureau of Fisheries were planted by the Massachusetts Fish Commission in Lake Quinsigamond, and during July, 1914, about 20 months after they were hatched, over 600 salmon, according to a member of the commission, were caught, ranging from $1\frac{1}{2}$ to 5 pounds each.

Other plants have been made since in Lake Quinsigamond and other lakes and ponds, with fairly satisfactory results, and the ultimate outcome of the experiment is awaited with much interest.

The most successful effort in this line was initiated by the United States Bureau of Fisheries in the fall of 1913, when it transferred from its hatcheries on the Pacific coast to those in Maine 13,240,000 humpback-salmon eggs. These were followed by a second shipment of 7,022,000 eggs in the fall of 1914, a third shipment of about 7,000,000 eggs in the fall of 1915, and others each year since. These eggs were hatched out and the fry planted in various selected New England streams where the conditions seemed favorable.

Early in August, 1915, a female humpback salmon $22\frac{1}{2}$ inches long and weighing 4 pounds 3 ounces was taken at the Bangor water-works in the Penobscot River. Shortly after a male fish of about the same size was taken in this river at Orland Dam. A little later agents of the Bureau captured 20 alive near Bangor, and about 3,000 eggs were obtained and fertilized.

In Dennys River, in Maine, during the period between August 15 and September 24, local fishermen caught a number. Since then they have been running regularly each season into certain of these streams.

The chinook salmon has also been acclimatized in the waters of New Zealand. They were first introduced in 1900, and eggs were imported for six years in succession. A considerable annual run now enters those rivers in which the salmon were planted.

In 1908 the United States Bureau of Fisheries initiated an effort to establish a run of sockeye salmon in Grandy Creek, a stream in the immediate vicinity of the Birdsvew (Wash.) hatchery of the Bureau, and one which had not been visited by this species. The first fish, numbering 64,000, were planted in the creek in 1908. Four years afterwards, in September, 1912, the first sockeye salmon entered the hatchery trap in Grandy Creek, and from them 222,000 eggs were secured. In 1916 the water in the creek was too low to permit the ascent of salmon until September 26, when its level was slightly raised by local rains, and a few fish immediately entered it and were taken in the hatchery trap. The eggs secured from the small number available amounted to 24,500. The 1920 run is being awaited with much interest.

In 1916 L. H. Darwin, commissioner of fish and game for the State of Washington, began an experiment looking to the stocking, with sockeye salmon, of the Samish River, a stream debouching in Puget Sound, and in which this species had not hitherto been found. The parent fish were obtained from traps and transported alive in crates to the Samish State hatchery, where they were held until ripe and then stripped and fertilized. After hatching, the fry were planted in the stream. A few returned in 1920.

CALIFORNIA.

HISTORY.

The first fish-cultural station on the Pacific coast was located on McCloud River, a stream of the Sierra Nevada Mountains emptying into Pit River, a tributary to the Sacramento, 323 miles nearly due north of San Francisco. The site on the west bank of the river, about 3 miles above the mouth, was chosen after investigation of a number of places on the Sacramento, by Livingston Stone, one of America's pioneer fish culturists, and the station was named Baird, in honor of the then Commissioner of Fisheries, Prof. Spencer F. Baird. Although the season had nearly passed when the station was sufficiently advanced to handle eggs, 50,000 eggs were secured, and while 20,000 were lost, owing to the excessive heat, the remaining 30,000 were shipped east, all of which were eventually lost but 7,000 fry, which were planted in the Susquehanna River, in Pennsylvania.

The main object of the hatchery the first few years was to secure eggs to ship to the East for the purpose of introducing Pacific salmon in the waters of that section. The commission early made an agreement with the State of California, however, under which the latter at first paid part of the expense, and the commission hatched and planted a portion of the take in the McCloud River. Later, part of the eggs were turned over to the State, which hatched and planted the salmon in local waters.

In 1881 the station buildings were washed away in a freshet, but were immediately rebuilt. From 1884 to 1887, both inclusive, all operations were suspended.

In 1889 a hatchery was established at Fort Gaston, on the Army reservation in the Hoopa Indian Reservation in Humboldt County, but it was not put into operation until 1890. As the reservation was abolished on July 1, 1892, the commission took complete charge of the plant, and in 1893 established a tributary station on Redwood Creek. The same year Korbel station was established about one-half mile above Korbel, on Mad River, in Humboldt County. Owing to the lack of money this station was closed in the fiscal year 1896, but was reopened during the fiscal year 1897.

That same year the commission erected, on ground owned by the State, a hatchery at Battle Creek, in Tehama County, and also took charge of and operated the hatchery erected at this place by the State fish commission the previous year. Under the terms of an agreement the commission was to deliver to the State as many eyed spawn as the latter could hatch at Sisson, its own station.

Owing to their inaccessibility, the Fort Gaston hatchery and its substations were abandoned in 1898. The same year an experimental station was established at Olema, Bear Valley, in Marin County, whence eggs were transferred from Baird station, hatched out here, and planted in Olema Creek in order to see if they could not be domesticated here, where they had not been found previously.

During the fiscal year 1902 a substation was established on Mill Creek, a stream which has its source in the foothills of the Sierra Mountains, in the northeastern part of Tehama County, and empties into the Sacramento River from the east about a mile above the town of Tehama. The eggs are retained here until eyed and then shipped to other hatcheries.



FIG 47.—UNITED STATES BUREAU OF FISHERIES HATCHERY AT BAIRD, CALIF.; THE FIRST FISH-CULTURAL STATION ON THE PACIFIC COAST.

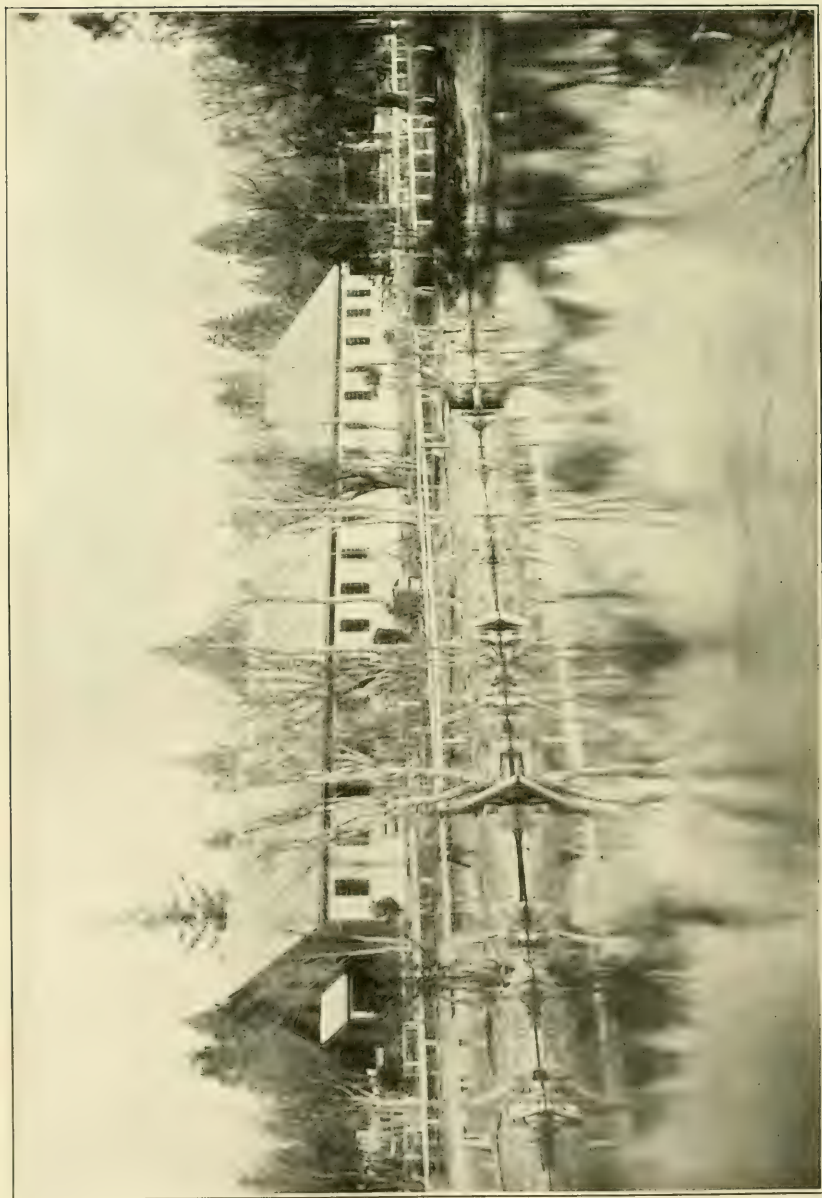


FIG. 48.—MOUNT SHASTA HATCHERY OF THE CALIFORNIA FISH AND GAME COMMISSION, AT SISSON, CALIF.

As stated above, the State aided the work of the United States Fish Commission in a financial way and also by hatching and distributing the eggs turned over to its care. In 1885 the State legislature passed a bill authorizing the establishment of a hatchery of its own, and the same year such a station was built upon Hat Creek about $2\frac{1}{2}$ miles above its junction with Pitt River, a tributary of the Sacramento River. As the work of the first few seasons developed that the location was unsuitable, the hatchery was removed in 1888 to Sisson, in Siskiyou County. It is now known as the Mount Shasta hatchery. The work of this hatchery was to handle the eggs turned over to it by the United States Fish Commission. It was almost doubled in size in 1917.

In 1895 another hatchery was built by the State near the mouth of Battle Creek, a tributary of the Sacramento River. In 1896 and 1897 this hatchery was operated jointly by the State and the United States Fish Commission while awaiting the appropriation of money by the commission to purchase it from the State.

In the fall of 1897 a hatchery was established by the State at Grizzly Bluff, on Price Creek, a tributary of Eel River, in Humboldt County, and in 1902 this hatchery made the first plant in the State of steelhead trout fry. In 1916 it was moved to a point on Eel River near Fort Seward.

Santa Cruz County has had a hatchery at Brookdale for a number of years. In 1911 it was leased to the State and operated by the latter during the seasons of 1911 and 1912. In 1913 the State gave up the lease and entered into a contract to purchase the eggs produced from this hatchery. The price agreed upon was that the State commission was to pay \$1.50 per thousand for the eyed steelhead eggs, up to the number of 2,000,000, and \$1 per thousand for all eggs up to 3,000,000, provided that the eggs were collected and eyed by a skilled fish culturist and would pass inspection before they were accepted. In 1916 the State leased the plant for a term of years.

A hatchery was established by the United States Bureau of Fisheries at Hornbrook, on Klamath River, in 1913. At first this hatchery was devoted to rainbow-trout work, but later the collection and distribution of silver and chinook salmon was taken up.

During the fall of 1911 the State established an experimental station at Sacramento in order to carry on a series of experiments to determine whether the eggs of the quinnat salmon could be successfully hatched and the fry reared near the city of Sacramento. Of the fish hatched at this station 50,000 were marked.

Nearly all of the fry that were liberated in the Sacramento River were floated in a screen cage by boat into the middle of the stream and there released. N. B. Scofield took 500 in a floating box down the river, where they were held and fed for several weeks in brackish and salt water. They were apparently not affected by the changes in the salinity of the water.

Experiments were carried on until the summer of 1913, when they were abandoned due to the killing of the embryos by the mineral substances in the water used at the station.

During the fiscal year 1912 the Mill Creek hatchery of the United States Bureau of Fisheries was operated by the California Commission.

Some years ago the town of Ukiah, Mendocino County, established a hatchery 1 mile from the town, and on Russian River.

For some years it was operated as a trout station, but eventually became an important steelhead hatchery. It was not operated in 1913. In 1914 the State Fish Commission collected steelhead eggs at the Eel River dam of the Snow Mountain Water & Power Co., and having secured permission from the town of Ukiah, hatched them out in its hatchery.

As the Hornbrook hatchery on Klamath River was on private property, the United States Bureau of Fisheries in 1915 removed the buildings from the old location on the south side to property owned by the Government on the north side of the river.

In 1915 new hatchery buildings were erected at the Mill Creek hatchery.

OUTPUT.

The following tables show separately the quantity of salmon eggs, fry, fingerlings, yearlings, and adults distributed by the United States Bureau of Fisheries and by the State since the inception of the work. The large quantity of eggs shown by the Bureau represents largely the eggs supplied to the State, which hatched and distributed them, and eggs sent to other States and to foreign countries.

OUTPUT OF HATCHERIES IN CALIFORNIA OWNED BY THE UNITED STATES BUREAU OF FISHERIES.

| Year ending June 30— <i>a</i> | Chinook. | | | Silver. | | |
|-------------------------------|-------------|-------------|-------------------------------------|-----------|-----------|-------------------------------------|
| | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
| 1872..... | 30,000 | | | | | |
| 1873..... | 1,400,000 | | | | | |
| 1874..... | 4,155,000 | 850,000 | | | | |
| 1875..... | 6,250,000 | 1,750,000 | | | | |
| 1876..... | 5,065,000 | 1,500,000 | | | | |
| 1877..... | 4,983,000 | 2,000,000 | | | | |
| 1878..... | 7,810,000 | 2,500,000 | | | | |
| 1879..... | 4,250,000 | 2,300,000 | | | | |
| 1880..... | 3,800,000 | 2,000,000 | | | | |
| 1881..... | 4,300,000 | 3,100,000 | | | | |
| 1882..... | | 3,991,750 | | | | |
| 1883..... | | 776,125 | | | | |
| 1889 <i>b</i> | 3,450,000 | 1,500,000 | | | | |
| 1890..... | 1,554,000 | 84,000 | | | | |
| 1891..... | 2,988,000 | 777,000 | | | | |
| 1892..... | 2,902,000 | 315,500 | | | | |
| 1893..... | 3,530,000 | 1,190,100 | | | | |
| 1894..... | 7,500,000 | 438,500 | | | 280,000 | |
| 1895..... | 3,676,000 | 500,000 | | | 690,000 | 560,000 |
| 1896..... | 6,170,800 | 715,700 | | | | |
| 1897..... | 18,232,590 | 3,056,701 | | | 298,137 | |
| 1898..... | 30,605,000 | 15,643,300 | | | | |
| 1899..... | 27,665,000 | 3,275,110 | | | | |
| 1900..... | 2,925,000 | 3,533,950 | | | | |
| 1901..... | 3,934,036 | 889,570 | | | | |
| 1902..... | 17,580,410 | 2,115,560 | | | | |
| 1903..... | 11,275,777 | 1,618,066 | | | | |
| 1904..... | 64,598,354 | 2,350,130 | | | | |
| 1905..... | 96,025,765 | 7,561,380 | | | | |
| 1906..... | 107,905,945 | 3,496,267 | 133 | | | |
| 1907..... | 73,376,315 | 2,512,250 | | | | |
| 1908..... | 64,990,550 | 4,780,855 | | | | |
| 1909..... | 32,278,265 | 3,590,078 | | | | |
| 1910..... | 30,539,467 | 2,286,257 | | | | |
| 1911..... | 33,364,514 | 3,066,061 | | 2,280,900 | | |
| 1912..... | 20,697,550 | 7,243,325 | | | | |
| 1913..... | 17,092,873 | 2,195,100 | | 100,000 | 17,320 | |
| 1914..... | 25,373,645 | 5,598,349 | 3,849,991 | 95,840 | 2,536,460 | |
| 1915..... | 20,716,005 | 5,015,400 | 8,086,139 | | 971,740 | 226,162 |
| 1916..... | 19,622,340 | 9,940,950 | 11,938,224 | | 2,169,050 | |
| 1917..... | 7,027,300 | 800,000 | 14,623,300 | | 50,000 | 11,000 |
| 1918..... | 14,421,900 | | 10,680,400 | | | |
| 1919..... | 11,802,500 | | 10,287,800 | | | |
| Total..... | 825,864,901 | 117,457,334 | 59,479,992 | 2,485,740 | 7,012,707 | 797,162 |

a The calendar year was used up to 1889.

b The hatchery was closed from 1881 to 1888.

OUTPUT OF HATCHERIES IN CALIFORNIA OWNED BY THE UNITED STATES BUREAU OF FISHERIES—Continued.

| Year ending June 30 — ^a | Steelhead trout. | | | Total. | | |
|------------------------------------|------------------|-----------|-------------------------------------|-------------|-------------|-------------------------------------|
| | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
| 1872..... | | | | 30,000 | | |
| 1873..... | | | | 1,400,000 | | |
| 1874..... | | | | 4,155,000 | 850,000 | |
| 1875..... | | | | 6,250,000 | 1,750,000 | |
| 1876..... | | | | 5,065,000 | 1,500,000 | |
| 1877..... | | | | 4,983,000 | 2,000,000 | |
| 1878..... | | | | 7,810,000 | 2,500,000 | |
| 1879..... | | | | 4,250,000 | 2,300,000 | |
| 1880..... | | | | 3,800,000 | 2,000,000 | |
| 1881..... | | | | 4,300,000 | 3,100,000 | |
| 1882..... | | | | | 3,991,750 | |
| 1883..... | | | | | 776,125 | |
| 1884..... | | | | 3,450,000 | 1,500,000 | |
| 1885..... | | | | 1,554,000 | 84,000 | |
| 1886..... | | | | 2,988,000 | 777,000 | |
| 1887..... | | | | 2,902,000 | 315,500 | |
| 1888..... | | | | 3,530,000 | 1,190,100 | |
| 1889..... | 75,000 | 308,500 | | 7,575,000 | 1,027,000 | |
| 1890..... | | 852,500 | 332,000 | 3,676,000 | 2,042,500 | 802,000 |
| 1891..... | 175,000 | 107,808 | | 6,345,800 | 823,508 | |
| 1892..... | 50,000 | 287,000 | | 18,282,500 | 3,611,838 | |
| 1893..... | 60,000 | 650,000 | | 30,655,000 | 16,263,300 | |
| 1894..... | | | | 27,665,000 | 3,275,110 | |
| 1895..... | | | | 2,925,000 | 3,533,950 | |
| 1896..... | | | | 3,934,036 | 889,570 | |
| 1897..... | | | | 17,589,410 | 2,115,560 | |
| 1898..... | | | | 11,275,777 | 1,618,066 | |
| 1899..... | | | | 64,598,354 | 2,350,120 | |
| 1900..... | | | | 96,025,765 | 7,561,380 | |
| 1901..... | | | | 107,905,945 | 3,496,267 | 138 |
| 1902..... | | | | 73,376,315 | 2,512,250 | |
| 1903..... | | | | 64,990,550 | 4,780,855 | |
| 1904..... | | | | 32,278,265 | 3,590,078 | |
| 1905..... | | | | 30,539,467 | 2,286,257 | |
| 1906..... | | | | 35,654,414 | 3,606,091 | |
| 1907..... | | | | 20,697,550 | 7,243,325 | |
| 1908..... | | | | 17,192,873 | 2,212,420 | |
| 1909..... | | | | 25,469,485 | 8,134,809 | 3,849,991 |
| 1910..... | | | | 20,716,005 | 5,987,140 | 8,312,301 |
| 1911..... | | | | 19,622,340 | 12,110,000 | 11,938,224 |
| 1912..... | | | | 7,027,300 | 850,000 | 14,639,300 |
| 1913..... | | | | 14,421,900 | | 10,689,400 |
| 1914..... | | | | 11,802,500 | | 10,287,800 |
| Total..... | 390,000 | 2,175,508 | 332,000 | 528,710,641 | 123,645,849 | 60,609,154 |

^a The calendar year was used up to 1889.^b The hatchery was closed from 1884 to 1888.

OUTPUT OF HATCHERIES OWNED BY THE STATE OF CALIFORNIA.

| Year. | Chinook. | | Silver fry. | Steelhead fry. | Total. | |
|------------|----------------------|-------------------|-------------|----------------|---------|-------------|
| | Eggs. | Fry. ^a | | | Eggs. | Fry. |
| 1873..... | | 520,000 | | | | 520,000 |
| 1874..... | | 850,000 | | | | 850,000 |
| 1875..... | ^b 250,000 | 2,250,000 | | | 250,000 | 2,250,000 |
| 1876..... | | 2,000,000 | | | | 2,000,000 |
| 1877..... | | 2,200,000 | | | | 2,200,000 |
| 1878..... | | 2,500,000 | | | | 2,500,000 |
| 1879..... | | 2,300,000 | | | | 2,300,000 |
| 1880..... | | 2,225,000 | | | | 2,225,000 |
| 1881..... | | 2,420,000 | | | | 2,420,000 |
| 1882..... | | 3,991,750 | | | | 3,991,750 |
| 1883..... | | 600,000 | | | | 600,000 |
| 1884..... | | 150,000 | | | | 150,000 |
| 1885..... | | 200,000 | | | | 200,000 |
| 1886..... | | 1,200,000 | | | | 1,200,000 |
| 1887..... | | 2,168,000 | | | | 2,168,000 |
| 1888..... | | 1,320,000 | | | | 1,320,000 |
| 1889..... | | 2,798,000 | | | | 2,798,000 |
| 1890..... | | 2,651,000 | | | | 2,651,000 |
| 1891..... | | 3,941,650 | | | | 3,941,650 |
| 1892..... | | 7,776,400 | | | | 7,776,400 |
| 1893..... | | 3,435,000 | | | | 3,435,000 |
| 1894..... | | 15,283,183 | | | | 15,283,183 |
| 1895..... | | 18,123,000 | | | | 18,123,000 |
| 1896..... | | 31,476,388 | | | | 31,476,388 |
| 1897..... | | 21,234,000 | | | | 21,234,000 |
| 1898..... | | 2,536,000 | | | | 2,536,000 |
| 1899..... | | 3,239,000 | | | | 3,239,000 |
| 1900..... | | 16,852,040 | | 301,000 | | 17,153,040 |
| 1901..... | | 20,040,487 | | 120,000 | | 20,160,487 |
| 1902..... | | 63,632,000 | | 90,000 | | 63,722,000 |
| 1903..... | | 87,000,000 | | 108,000 | | 87,108,000 |
| 1904..... | | 105,815,920 | | 243,000 | | 106,058,920 |
| 1905..... | | 71,267,000 | | 352,000 | | 71,619,000 |
| 1906..... | | 60,619,000 | | 170,000 | | 60,789,000 |
| 1907..... | | 28,000,000 | | 517,000 | | 28,517,000 |
| 1908..... | | 28,469,745 | | 637,800 | | 29,107,545 |
| 1909..... | | 29,657,263 | 2,060,910 | 1,858,100 | | 33,576,273 |
| 1910..... | | 18,909,445 | | 2,177,958 | | 21,087,403 |
| 1911..... | | 16,277,227 | 25,000 | 1,983,500 | | 18,285,727 |
| 1912..... | | 25,290,615 | 12,500 | 3,171,083 | | 28,474,198 |
| 1913..... | | 33,313,150 | 1,417,000 | 8,582,500 | | 43,312,650 |
| 1914..... | | 19,339,738 | | 5,213,170 | | 24,552,908 |
| 1915..... | | 6,853,000 | | 6,699,420 | | 13,552,420 |
| 1916..... | | 14,439,000 | | 4,483,000 | | 18,922,000 |
| 1917..... | | 11,970,000 | 178,000 | 4,950,000 | | 17,098,000 |
| 1918..... | | | | | | |
| 1919..... | | | | | | |
| Total..... | 250,000 | 797,224,001 | 3,693,410 | 41,657,531 | 250,000 | 842,574,942 |

^a The greater part of the output of chinook fry was from eggs supplied by the U. S. Bureau of Fisheries hatcheries in California.

^b All were lost.

DISTRIBUTION.

The following table shows, by streams and species, the distribution in California of the salmon eggs, fry, fingerlings, yearlings, and adults, from the hatcheries of the United States Bureau of Fisheries and the State. This far from represents the work of the hatcheries, as large quantities of eggs were sent to other States and foreign countries.

DISTRIBUTION OF SALMON IN THE WATERS OF CALIFORNIA.

| Year. | Klamath River and tributaries. | | | | Redwood Creek and tributaries. | | | |
|-----------|--------------------------------|------------|-----------|-----------------------|--------------------------------|---------|-----------------------|-----------------|
| | Chinook. | | Silver. | | Chinook fry. | Silver. | | Steel-head fry. |
| | Fry. | Yearlings. | Fry. | Yearlings and adults. | | Fry. | Yearlings and adults. | |
| 1890. | 90,000 | | | | | | | |
| 1891. | 30,000 | | | | 25,000 | | | |
| 1892. | 147,600 | 25,000 | | | 142,500 | | | |
| 1893. | 487,200 | | | | 170,000 | | | |
| 1895. | | | 300,000 | 160,000 | | 140,000 | 400,000 | |
| 1896. | | | | | 65,700 | | | 107,808 |
| 1897. | | | | | 280,250 | 124,750 | | 202,000 |
| 1898. | 16,000 | | | | 1,260,000 | | | 650,000 |
| 1903. | 40,000 | | | | | | | |
| 1911. | | | 2,000,910 | | | | | |
| 1913. | | | 17,320 | | | | | |
| 1914. | 2,155,100 | | 2,548,960 | | | | | |
| 1915. | 5,820,000 | | 1,098,000 | | | | | |
| 1916. | 7,733,135 | | 2,169,030 | | | | | |
| 1917. | 1,728,000 | 368,000 | 50,000 | 11,000 | | | | |
| 1918. | 3,675,000 | | | | | | | |
| 1919. | 1,148,000 | | 178,000 | | | | | |
| Total.... | 23,070,035 | 393,000 | 8,422,240 | 171,000 | 1,943,450 | 264,750 | 400,000 | 959,808 |

| Year. | Mad River and North Fork. | | | Eel River. | | Russian River. | Skaggs Springs. | Marin County creeks. |
|-----------|---------------------------|-------------|-----------------|--------------|-----------------|----------------|-----------------|----------------------|
| | Chinook fry. | Silver fry. | Steel-head fry. | Chinook fry. | Steel-head fry. | Chinook fry. | | |
| | | | | | | | | |
| 1881. | | | | | | 15,000 | 15,000 | |
| 1894. | | 280,000 | 308,500 | | | | | |
| 1895. | | 470,000 | | | | | | |
| 1897. | 145,365 | 173,387 | 60,000 | | | | | 635,000 |
| 1898. | | | | 7,857,388 | | | | 1,970,000 |
| 1899. | | | | 8,202,000 | | | | 900,000 |
| 1900. | | | | 885,000 | | | | |
| 1902. | | | | 2,069,500 | 301,000 | | | |
| 1903. | | | | 5,257,947 | 120,000 | | | |
| 1904. | | | | 5,200,000 | 90,000 | | | |
| 1905. | | | | 8,100,000 | | | | |
| 1906. | | | | 9,265,920 | 245,000 | | | |
| 1907. | | | | 7,570,000 | 352,000 | 25,000 | | 25,000 |
| 1908. | | | | 6,154,000 | | | | |
| 1909. | | | | 5,500,000 | 349,000 | | | |
| 1910. | | | | 5,969,745 | 331,800 | | | |
| 1912. | 100,000 | | | 3,103,660 | | | | |
| 1913. | 100,000 | | | 1,386,500 | | | | |
| 1914. | 225,000 | | | 3,723,000 | | | | |
| 1915. | 350,000 | | | 2,618,150 | | | | |
| 1917. | 400,000 | | | 91,000 | | | | |
| 1918. | 250,000 | | | 844,000 | | | | |
| 1919. | 250,000 | | | 682,000 | | | | |
| Total.... | 1,820,365 | 923,387 | 368,500 | 84,479,810 | 1,789,800 | 40,000 | 15,000 | 3,530,000 |

DISTRIBUTION OF SALMON IN THE WATERS OF CALIFORNIA—Continued.

| Year. | Sacramento River and tributaries. | | | | | San Francisco Bay streams. | Smith River. | Santa Ynez River. | Monte-rey Bay and tributaries. |
|----------|-----------------------------------|--------------|--------------------------------------|-------------|-----------------|----------------------------|--------------|-------------------|--------------------------------|
| | Chinook. | | | Silver fry. | Steel-head fry. | Chinook fry. | | | |
| | Eggs. | Fry. | Yearlings, finger-lings, and adults. | | | | | | |
| 1873. | 20,000 | 520,000 | | | | | | | |
| 1874. | | 850,000 | | | | | | | |
| 1875. | a 250,000 | 2,000,000 | | | | | | | |
| 1876. | | 2,000,000 | | | | | | | |
| 1877. | | 2,200,000 | | | | | | | |
| 1878. | | 2,500,000 | | | | | | | |
| 1879. | | 2,300,000 | | | | | | | |
| 1880. | | 2,225,000 | | | | | | | |
| 1881. | | b 2,300,500 | | | | 20,000 | | | 30,000 |
| 1882. | 80,300 | 3,991,750 | | | | | | | |
| 1884. | | 600,000 | | | | | | | |
| 1886. | | 150,000 | | | | | | | |
| 1887. | | 200,000 | | | | | | | |
| 1888. | | 1,290,000 | | | | | | | |
| 1889. | | 3,668,000 | | | | | | | |
| 1890. | | 1,404,000 | | | | | | | |
| 1891. | | 3,520,000 | | | | | | | |
| 1892. | | 2,676,500 | | | | | | | |
| 1893. | | 4,474,750 | | | | | | | |
| 1894. | | 8,214,900 | | | 45,000 | | | | |
| 1895. | | 3,935,000 | | | | | | | |
| 1896. | | 15,683,183 | 250,000 | | | | | | |
| 1897. | | 19,264,086 | | | | | | | |
| 1898. | | 33,998,300 | | | | | | | |
| 1899. | 85,200 | 16,307,110 | | | | | | | |
| 1900. | | 5,184,950 | | | | | | | |
| 1901. | | 4,128,570 | | | | | | | |
| 1902. | | 16,898,100 | | | | | | | |
| 1903. | | 16,359,606 | | | | | | | |
| 1904. | | 60,782,130 | | | | | | | |
| 1905. | | 94,561,380 | | | 108,000 | | | | |
| 1906. | | 100,038,552 | | | | | | | 900,000 |
| 1907. | | 66,209,250 | | | 135,000 | | | | 1,200,000 |
| 1908. | | 59,245,855 | | | 170,000 | | | | 800,000 |
| 1909. | | 26,090,000 | | | 168,000 | | | | |
| 1910. | | 21,786,257 | | | 303,000 | | | | |
| 1911. | | 33,323,324 | | | | | | | |
| 1912. | | 22,949,110 | | | | | | | |
| 1913. | | 16,691,167 | | | | 294,660 | | | |
| 1914. | | 24,637,864 | 838,906 | | | | 100,000 | | |
| 1915. | | c 28,688,000 | 9,033,635 | 1,194,762 | | | | 42,000 | |
| 1916. | | 26,800,604 | 5,538,224 | | | | 300,000 | 25,000 | |
| 1917. | | 5,875,000 | 14,260,300 | | | | | 25,000 | |
| 1918. | | 9,470,000 | 10,689,400 | | | | 100,000 | 25,000 | |
| 1919. | | 9,840,000 | 10,287,000 | | | | | 25,000 | |
| Total... | 435,500 | 788,832,798 | 50,917,465 | 1,194,762 | 929,000 | 314,660 | 500,000 | 142,000 | 2,930,000 |

a All were lost.

b Includes 15,000 chinook fry planted in San Gregorio River and 15,000 chinook fry planted in Pescadero Creek.

c Includes the following plants in Santa Barbara county streams: Bear Creek, 4,000; Maguelito Creek, 2,000; and Salispuedes Creek, 2,000.

DISTRIBUTION OF SALMON IN THE WATERS OF CALIFORNIA—Continued.

| Year. | Mon- terey Bay and tributaries. | Ven- tura River. | Truckee River. ^a | Total. | | | | |
|------------|---|------------------------|-----------------------------------|---------|---|------------|----------------------------------|-------------------------------------|
| | Silver fry. | Chinook fry. | Chinook. | | | Silver. | | Steel- head fry. ^b |
| | | | Eggs. | Fry. | Year- lings, finger- lings, and adults. ^a | Fry. | Adults and year- lings. | |
| 1873 | | | | 20,000 | 520,000 | | | |
| 1874 | | | | | 850,000 | | | |
| 1875 | | | 250,000 | 250,000 | 2,250,000 | | | |
| 1876 | | | | | 2,000,000 | | | |
| 1877 | | | | | 2,200,000 | | | |
| 1878 | | | | | 2,500,000 | | | |
| 1879 | | | | | 2,300,000 | | | |
| 1880 | | | | | 2,225,000 | | | |
| 1881 | | | 10,000 | | 2,390,500 | | | |
| 1882 | | | | 80,300 | 3,991,750 | | | |
| 1883 | | | | | 600,000 | | | |
| 1884 | | | | | 150,000 | | | |
| 1885 | | | | | 200,000 | | | |
| 1886 | | | | | 1,200,000 | | | |
| 1887 | | | | | 3,608,000 | | | |
| 1888 | | | | | 1,494,000 | | | |
| 1889 | | | | | 3,575,000 | | | |
| 1890 | | | | | 2,966,600 | 25,000 | | |
| 1891 | | | | | 5,131,950 | | | |
| 1892 | | | | | 8,214,900 | | | |
| 1893 | | | | | 3,935,000 | | 280,000 | 353,500 |
| 1894 | | | | | 15,748,883 | 250,000 | 910,000 | 560,000 |
| 1895 | | | | | 20,324,701 | | | 107,808 |
| 1896 | | | | | 45,101,088 | | 298,137 | 262,000 |
| 1897 | | | | | 25,409,110 | | | 650,000 |
| 1898 | | | | 85,200 | 6,069,950 | | | |
| 1899 | | | | | 4,128,570 | | | |
| 1900 | | | | | 18,967,600 | | | 301,000 |
| 1901 | | | | | 21,657,553 | | | 120,000 |
| 1902 | | | | | 65,982,130 | | | 90,000 |
| 1903 | | | | | 102,661,380 | | | 108,000 |
| 1904 | | | | | 110,204,472 | | | 243,000 |
| 1905 | 80,000 | | | | 75,029,250 | | 80,000 | 487,000 |
| 1906 | 80,000 | | | | 66,199,855 | | 80,000 | 170,000 |
| 1907 | 104,000 | | | | 31,590,000 | | 42,000 | 518,200 |
| 1908 | | | | | 30,756,002 | | | 637,800 |
| 1909 | | | | | 33,323,324 | | 2,060,910 | 1,858,100 |
| 1910 | | | | | 26,152,770 | | | 2,177,958 |
| 1911 | 25,000 | | | | 18,472,327 | | 42,320 | 1,983,500 |
| 1912 | | | | | 30,840,964 | 838,906 | 2,548,960 | 3,171,083 |
| 1913 | 71,000 | 25,000 | | | 37,543,150 | 9,053,635 | 2,363,762 | 8,582,500 |
| 1914 | | 25,000 | | | 34,883,739 | 5,538,224 | 2,169,050 | 5,213,170 |
| 1915 | | 25,000 | | | 8,144,000 | 14,628,300 | 50,000 | 11,000 |
| 1916 | | 25,000 | | | 14,389,000 | 10,689,400 | | 6,699,420 |
| 1917 | | 25,000 | | | 11,970,000 | 10,287,000 | 178,000 | 4,950,000 |
| 1918 | | | | | | | | |
| 1919 | | | | | | | | |
| Total..... | 310,000 | 125,000 | 260,000 | 125,500 | 908,003,118 | 51,310,465 | 11,103,139 | 571,000 |
| | | | | | | | | 38,684,039 |

^a Of recent years it has been impossible to show the total number of yearlings, fingerlings, and adults planted, as the State reports do not distinguish them from the fry. Those shown in 1914-1919 were reared by the U. S. Bureau of Fisheries.

^b After 1911 the practice of showing waters in which steelheads were planted was abandoned as the number of streams was becoming unwieldy.

^c Includes 1,200 steelhead fry, which in "Total" column are included under "Steelhead fry."

OREGON.

HATCHERIES ON COASTAL STREAMS.

Rogue River.—In 1877 R. D. Hume, who had been packing salmon on this river for some years, erected a hatchery at Ellensburg. In 1888 the Oregon Legislature appropriated a sum of money for the enlargement and support of this hatchery, Mr. Hume to retain complete control. As the location is on tidewater, it is necessary to catch the parent fish and hold them until they are ready to spawn, and in order to do this Mr. Hume had an excavation 32 by 62 feet and 11 feet deep made in the bank of the river. This was lined with concrete 1 foot thick, which, when filled with water, made a pond 30 by 60 feet and 10 feet deep. Over the entire pond he constructed a building which could be closed up so as virtually to exclude the light. It is supposed that retaining the fish in a dark place aids in keeping them in good physical condition until ready to spawn. After the death of Mr. Hume in 1908 this hatchery was taken over and operated by the State.

In 1897 Mr. Hume built and equipped a hatchery on the upper Rogue River at the mouth of Elk Creek, about 26 miles from the town of Central Point, in Jackson County, and, in pursuance of an understanding with the United States Fish Commission, the latter operated then and still continues to operate this plant.

In 1900 the Government established an auxiliary station for the collection of steelhead trout eggs on Elk Creek, about 10 miles above the main station. In 1905 a substation was operated at Grants Pass, while during the fiscal year 1908 and in subsequent years substations were operated at Findley Eddy, on the Rogue River, Illinois River, and Applegate Creek, tributaries of the Rogue.

Many of the eggs gathered at the upper Rogue River stations were shipped to Mr. Hume's hatchery, on the lower river, and there hatched out and planted.

Coquille River.—The State formerly had a hatchery on this river, but it was abandoned during the winter of 1902-3. In the winter of 1904-5 a substation was established on one of the tributaries of the Coquille River, about 6 miles from the South Coos River hatchery, and was used in hatching eggs brought to it from the latter place. A station was built on the north fork of the Coquille River in 1910.

Coos River.—A hatchery was built by the State in 1900 on the South Coos River, about 20 miles from the town of Marshfield.

Umpqua River.—In 1900 the State built a hatchery on the north fork of the Umpqua River, near the town of Glide and about 24 miles east of Roseburg. In 1901 a station was established farther up the north fork, at the mouth of Steamboat Creek. After working here two years the station was moved a couple of miles farther up the stream. In 1907 work was resumed again at the original station near Glide, as winter freshets had seriously damaged the upper station. A permanent station was built in 1910.

Siuslaw River.—In 1893 the State erected a hatchery on Knowles Creek, a tributary of the Siuslaw River, about 20 miles above the mouth of the river. It was turned over to the United States Fish Commission to operate, but no fish came up to the hatchery because the fishermen lower down stretched their nets entirely across the river.

In 1897 and 1898 the United States Fish Commission operated a hatchery owned by a Mr. McGuire and located close to Mapleton, about 2 miles below the head of tidewater.

In 1902 the State established an experimental station at the Bailey place, near Meadow post office. In 1907 a permanent station was established by the State on Land Creek fork of the Siuslaw River.

Alsea River.—In 1902 the State established a station on the Willis Vidito place, near the town of Alsea. In 1907 an experimental station was established on this river at the mouth of Rock Creek, about 14 miles above the head of tidewater. In 1910 an experimental station was established between Alsea and tidewater.

Yaquina River.—In 1902 the State established a hatching station on the Big Elk River, a tributary of Yaquina River, about 3 miles above its confluence with the main river. This station was made permanent the next year.

Tillamook Bay.—In 1902 the State established a station on Wilson River, a tributary of Tillamook Bay, and about 8 miles above tidewater. In 1906 the station was removed to the Trask River, a tributary of Tillamook Bay.

DISTRIBUTION.

The following table shows the distribution of fry and fingerlings in the coastal streams of the State by the Government and the State:

DISTRIBUTION OF SALMON IN THE COASTAL STREAMS OF OREGON.

| Year ending June 30— | Tillamook Bay and tributaries. | | | Yaquina River. | | | Alsea River. | | |
|----------------------|--------------------------------|------------------|-----------------|----------------|------------------|-----------------|--------------|------------------|-----------------|
| | Chinook fry. | Silver-side fry. | Steel-head fry. | Chinook fry. | Silver-side fry. | Steel-head fry. | Chinook fry. | Silver-side fry. | Steel-head fry. |
| 1898 | 19,994 | | | | | | | | |
| 1899 | | | | 213,500 | | | | | |
| 1900 | 251,875 | | | 557,700 | | | 67,750 | | |
| 1901 | 799,399 | | | 3,141,380 | 985,220 | | | | |
| 1902 | | | | 1,407,470 | 3,009,075 | 780,500 | 1,000,000 | 1,000,000 | |
| 1903 | | | | 816,608 | 4,178,000 | 1,033,150 | 806,938 | 1,785,351 | |
| 1904 | | | | 1,919,508 | 1,955,793 | 376,245 | | | |
| 1905 | | | | 2,193,943 | 909,855 | | 199,700 | 812,300 | |
| 1906 | | | | 485,500 | 1,006,309 | | | | |
| 1907 | 312,700 | 2,648,000 | | 324,038 | 28,815 | | | | |
| 1908 | 2,121,000 | 1,629,000 | | 582,785 | 2,637,550 | 621,015 | 495,950 | 30,300 | |
| 1909 | | 4,896,000 | 569,690 | 148,992 | 1,554,602 | 7,145 | 287,645 | 997,455 | |
| 1910 | 621,800 | 3,506,900 | 2,309,770 | 727,567 | 3,288,650 | | 87,935 | 424,925 | |
| 1911 | 1,818,245 | 1,080,000 | 1,196,000 | | | | | | |
| 1912 | 646,300 | 1,578,131 | 761,000 | | | | | | |
| 1913 | 1,717,530 | 422,886 | 848,229 | | | | | | |
| 1914 | 487,692 | 1,112,392 | 660,588 | | | | | | |
| 1915 | 2,833,428 | | 213,900 | | | | | | |
| 1916 | 1,982,724 | 130,130 | | | | | 646,431 | | |
| 1917 | 2,143,430 | 183,800 | 495,090 | | | | 1,373,100 | 1,649,830 | 1,495,315 |
| 1918 | 1,412,400 | 534,600 | | | | | 869,370 | 1,107,483 | |
| 1919 | 705,656 | 2,097,442 | 384,370 | | | | 1,151,720 | 1,872,473 | 1,753,104 |
| Total | 17,940,074 | 19,819,371 | 7,438,637 | 12,521,091 | 19,553,869 | 2,818,055 | 6,956,539 | 9,680,117 | 3,248,419 |

• All fingerlings.

DISTRIBUTION OF SALMON IN THE COASTAL STREAMS OF OREGON—Continued.

| Year ending June 30— | Siuslaw River. | | | Umpqua River. | | Coos Bay and tributaries. | | |
|-------------------------|----------------|------------------|-----------------|---------------|-----------------|---------------------------|------------------|-----------------|
| | Chinook fry. | Silver-side fry. | Steel-head fry. | Chinook fry. | Steel-head fry. | Chinook fry. | Silver-side fry. | Steel-head fry. |
| 1897 | 180,000 | | | | | | | |
| 1898 | 440,275 | | | | | | | |
| 1899 | 2,700,000 | | | | | | | |
| 1900 | 213,500 | | | 730,000 | | 235,000 | | |
| 1901 | 112,000 | 214,800 | | 1,136,000 | | 2,416,350 | | |
| 1902 | 389,239 | | | 1,596,213 | | | | |
| 1903 | 822,567 | | | 1,399,860 | | 4,079,274 | | |
| 1904 | 435,162 | 311,900 | | 2,654,925 | | 3,877,172 | | |
| 1905 | 1,826,531 | 1,296,732 | 397,355 | 4,903,700 | | 2,744,000 | | |
| 1906 | 608,949 | 1,030,486 | | 4,685,900 | | 4,014,400 | | |
| 1907 | 729,130 | 1,127,293 | | 2,378,853 | | 3,000,000 | | |
| 1908 | 191,267 | 1,092,540 | 98,243 | 4,093,848 | | 2,084,500 | 1,032,000 | 222,000 |
| 1909 | 273,352 | 25,289 | | 5,686,273 | | 1,683,738 | | |
| 1910 | 594,702 | 20,693 | 227,580 | 2,541,236 | 293,996 | 2,374,200 | | |
| 1911 | 715,758 | 504,429 | 72,097 | 1,053,516 | | 1,767,170 | 2,317,370 | |
| 1912 | 255,028 | 627,312 | 106,717 | 903,704 | 181,085 | 1,281,120 | 962,528 | |
| 1913 | 1,062,546 | 476,273 | 17,735 | 1,882,985 | 80,000 | 1,331,217 | 2,973,390 | |
| 1914 | 972,395 | | 257,850 | 1,333,171 | | 1,212,805 | 1,551,645 | 192,625 |
| 1915 | a 972,395 | | | a1 216,518 | | a2 236,229 | a2 492,217 | |
| 1916 | 984,945 | 153,662 | | 918,622 | 65,200 | 2,370,000 | 1,089,500 | |
| 1917 | 529,904 | 147,475 | | 1,402,700 | | 1,208,840 | 1,193,960 | |
| 1918 | 743,037 | | | 3,259,258 | | 1,932,210 | 2,416,680 | |
| 1919 | | | | | | | | |
| Total | 16,252,717 | 7,028,884 | 1,177,577 | 43,777,282 | 620,281 | 39,848,225 | 16,029,290 | 414,625 |

| Year ending June 30— | Coquille River. | | Rogue River and tributaries. | | | |
|----------------------|-----------------|-----------------|------------------------------|-------------------------------------|-----------------|----------------|
| | Chinook fry. | Silverside fry. | Chinook. | | Silverside fry. | Steelhead fry. |
| | | | Fry. | Yearlings, fingerlings, and adults. | | |
| 1877 | | | 50,000 | | | |
| 1898 | | | 1,910,045 | | | |
| 1900 | | | 2,156,945 | | | |
| 1901 | 235,000 | | 2,967,058 | | 128,000 | 65,850 |
| 1902 | | | 4,750,763 | | 424,530 | 20,250 |
| 1903 | 3,084,577 | | 3,480,300 | | 680,800 | |
| 1904 | 1,000,000 | | 9,023,428 | | | 8,073 |
| 1905 | 2,210,000 | | 4,758,653 | | 1,250,432 | 531,000 |
| 1906 | 2,978,700 | | 47,500 | 75,000 | | 12,625 |
| 1907 | 2,840,000 | | 5,880,290 | | 1,375,000 | 105,300 |
| 1908 | 2,450,000 | 226,600 | 6,597,027 | 170,051 | 158,000 | 937,680 |
| 1909 | | 1,185,800 | 771,710 | | 643,000 | 878,847 |
| 1910 | | | 1,430,292 | | | 89,850 |
| 1911 | 500,000 | 980,770 | 1,364,248 | | 501,081 | 2,592,665 |
| 1912 | 196,855 | 1,672,850 | 9,574,340 | | 2,355,885 | b 1,313,890 |
| 1913 | 496,680 | 962,528 | 4,169,150 | | 3,198,346 | 2,795,075 |
| 1914 | 491,580 | 1,331,910 | 3,752,483 | | c 7,832,000 | 1,376,308 |
| 1915 | 495,333 | 1,365,815 | 4,747,623 | 9,309 | 2,336,359 | d 3,908,699 |
| 1916 | a 1,465,321 | a 1,451,858 | 2,515,500 | 2,517,892 | e 198,103 | f 3,083,092 |
| 1917 | 1,109,500 | 674,293 | 171,500 | 1,758,800 | g 399,700 | h 561,955 |
| 1918 | 1,219,628 | 1,098,650 | | 900,750 | 366,500 | 2,810,700 |
| 1919 | 1,491,210 | 1,469,440 | | 1,032,950 | 592,150 | 807,000 |
| Total | 22,255,384 | 12,420,514 | 70,118,855 | 6,464,752 | 22,439,886 | 21,898,859 |

a All fingerlings.

b Includes 177,790 fingerlings, yearlings, and adults.

c Includes 860,903 fingerlings, yearlings, and adults.

d Includes 27,258 fingerlings.

e Includes 9,153 fingerlings.

f Includes 2,583,092 fingerlings; all were planted by U. S. Bureau of Fisheries.

g Includes 6,000 fingerlings.

h Includes 128,600 fingerlings.

DISTRIBUTION OF SALMON IN THE COASTAL STREAMS OF OREGON—Continued.

| Year ending June 30— | Total. | | | | Grand total, all species. |
|----------------------|-------------|-------------------------------------|-----------------|----------------|---------------------------|
| | Chinook. | | | Steelhead fry. | |
| | Fry. | Yearlings, fingerlings, and adults. | Silverside fry. | | |
| 1877..... | 50,000 | | | | 50,000 |
| 1897..... | 180,000 | | | | 180,000 |
| 1898..... | 2,370,314 | | | | 2,370,314 |
| 1899..... | 2,700,000 | | | | 2,700,000 |
| 1900..... | 2,156,945 | | | | 2,156,945 |
| 1901..... | 4,594,058 | | 128,000 | 65,850 | 4,787,908 |
| 1902..... | 8,415,113 | | 639,330 | 20,250 | 9,074,693 |
| 1903..... | 9,427,654 | | 680,800 | | 10,108,454 |
| 1904..... | 20,268,809 | | 985,220 | 8,073 | 21,262,102 |
| 1905..... | 16,343,382 | | 5,571,407 | 1,311,500 | 23,226,289 |
| 1906..... | 14,123,977 | 75,000 | 7,260,083 | 1,443,130 | 22,902,190 |
| 1907..... | 20,261,747 | | 7,009,279 | 481,545 | 27,752,571 |
| 1908..... | 19,671,753 | 170,051 | 4,863,048 | 997,680 | 25,642,532 |
| 1909..... | 7,626,825 | | 9,855,649 | 1,768,780 | 19,251,254 |
| 1910..... | 10,022,493 | | 3,561,094 | 2,399,620 | 15,983,207 |
| 1911..... | 10,271,366 | | 5,250,394 | 4,931,256 | 20,453,016 |
| 1912..... | 14,390,576 | | 10,980,722 | 2,154,132 | 27,525,430 |
| 1913..... | 9,668,714 | | 9,887,175 | 3,931,106 | 23,486,995 |
| 1914..... | 9,008,503 | | 13,725,965 | 2,134,631 | 24,869,099 |
| 1915..... | 12,094,770 | 9,309 | 5,253,819 | 4,573,074 | 21,930,972 |
| 1916..... | 2,515,500 | 11,037,510 | 4,272,308 | 3,083,092 | 20,908,410 |
| 1917..... | 9,062,697 | 1,758,800 | 4,150,785 | 2,617,560 | 17,589,242 |
| 1918..... | 6,672,842 | 900,750 | 4,448,668 | 2,810,700 | 14,832,960 |
| 1919..... | 9,283,111 | 1,032,950 | 8,448,185 | 2,944,474 | 21,708,720 |
| Total..... | 221,189,549 | 14,984,370 | 106,971,931 | 37,616,453 | 389,753,303 |

The following tables show separately the total output of the hatcheries in Oregon owned by the United States Bureau of Fisheries and of those owned by the State:

OUTPUT OF HATCHERIES IN OREGON OWNED BY THE U. S. BUREAU OF FISHERIES.

| Year ending June 30— | Chinook. | | | Silverside. | | |
|----------------------|------------|-------------|-------------------------------------|-------------|------------|-------------------------------------|
| | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
| 1889..... | | 4,500,000 | | | | |
| 1890..... | 1,000,000 | 2,776,475 | | | | |
| 1891..... | 700,000 | 4,901,525 | | | | |
| 1892..... | | 1,332,400 | | | | |
| 1893..... | | 4,100,000 | | | | |
| 1894..... | | 213,000 | | | | |
| 1895..... | 23,000 | | | | | |
| 1896..... | | 2,832,150 | 6557,150 | | | |
| 1897..... | | 4,922,634 | | | | |
| 1898..... | | 16,915,512 | | | | |
| 1899..... | 27,000 | 4,300,200 | | | | |
| 1900..... | 1,800,000 | 4,126,367 | | | | |
| 1901..... | 1,100,000 | 1,669,857 | 1,668 | | 146,824 | |
| 1902..... | 1,806,000 | 11,587,061 | | | 128,000 | |
| 1903..... | 4,884,400 | 5,453,860 | 250 | 680,800 | 424,530 | |
| 1904..... | 3,113,000 | 15,270,675 | | | | |
| 1905..... | 30,000 | 9,822,636 | | | 1,250,432 | |
| 1906..... | 28,200 | 2,454,371 | 122,980 | | | 300 |
| 1907..... | 1,661,390 | 8,542,104 | | | | |
| 1908..... | 2,045,000 | 7,844,827 | 627,856 | | 158,000 | 57,932 |
| 1909..... | 3,531,000 | 5,021,655 | 2,763 | | 1,799,915 | |
| 1910..... | 3,953,992 | 4,220,197 | 225 | | | |
| 1911..... | 600,000 | 5,686,168 | 200,000 | | 1,659,681 | |
| 1912..... | 8,000,000 | 12,837,840 | 750,765 | | 2,355,885 | |
| 1913..... | 21,491,000 | 11,291,023 | | | 3,198,346 | |
| 1914..... | 1,075,000 | 12,156,818 | 602,300 | | 8,441,642 | 27,258 |
| 1915..... | 37,000 | 10,434,517 | 531,351 | 76,260 | 2,373,559 | |
| 1916..... | 1,000,000 | 9,916,900 | 3,556,161 | 196,000 | 488,950 | 9,153 |
| 1917..... | 163,900 | 634,500 | 7,364,500 | | 393,700 | 92,100 |
| 1918..... | 3,000 | 3,843,700 | 11,284,150 | | 8,000 | 385,300 |
| 1919..... | 20,000 | | 5,325,450 | | | 594,350 |
| Total..... | 58,152,882 | 189,608,972 | 30,927,569 | 953,000 | 22,827,464 | 1,166,393 |

a All but 17,000 of these were from eggs received from the California stations.

b All raised from eggs received from the California stations.

OUTPUT OF HATCHERIES IN OREGON OWNED BY THE U. S. BUREAU OF FISHERIES—
Continued.

| Year ending June 30— | Steelhead trout. | | | Total. | | |
|----------------------|------------------|------------|---|------------|-------------|---|
| | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
| 1889 | | | | | 4,500,000 | |
| 1890 | | | | 1,000,000 | 2,776,475 | |
| 1891 | | | | 700,000 | 4,901,525 | |
| 1892 | | | | | 1,332,400 | |
| 1893 | | | | | 4,100,000 | |
| 1894 | | | | | 213,000 | |
| 1895 | | | | 23,000 | | |
| 1896 | | | | | 2,832,150 | 557,150 |
| 1897 | | | | | 4,922,634 | |
| 1898 | | | | | 16,915,512 | |
| 1899 | 159,000 | 12,125 | | 188,000 | 4,312,325 | |
| 1900 | 415,000 | 99,000 | | 2,215,000 | 4,372,191 | |
| 1901 | 246,000 | 65,850 | 25,000 | 1,346,000 | 1,863,707 | 26,668 |
| 1902 | 481,000 | 20,250 | | 2,347,000 | 12,031,841 | |
| 1903 | 400,000 | 262,700 | 62,033 | 5,965,200 | 5,716,560 | 62,283 |
| 1904 | | 23,205 | 11,090 | 3,113,000 | 15,293,880 | 11,090 |
| 1905 | 50,000 | 534,000 | | 80,000 | 11,607,068 | |
| 1906 | 10,000 | 1,294,485 | 40,383 | 38,200 | 3,748,856 | 163,663 |
| 1907 | 50,000 | 105,300 | | 1,711,390 | 8,647,404 | |
| 1908 | 263,725 | 952,680 | | 2,308,725 | 8,955,507 | 685,788 |
| 1909 | 51,468 | 1,374,308 | | 3,582,468 | 8,195,878 | 2,763 |
| 1910 | | 2,074,188 | | 3,953,992 | 6,294,385 | 225 |
| 1911 | | 2,914,789 | | 600,000 | 10,260,638 | 200,000 |
| 1912 | | 2,005,100 | 294,090 | 8,000,000 | 17,198,825 | 1,044,855 |
| 1913 | | 2,795,075 | | 21,491,000 | 17,284,444 | |
| 1914 | | 2,230,008 | | 1,075,000 | 22,828,468 | 629,558 |
| 1915 | 752,000 | 3,254,275 | 910,652 | 865,200 | 16,062,351 | 1,442,003 |
| 1916 | 450,000 | 500,000 | 2,785,805 | 1,646,000 | 10,905,850 | 6,351,119 |
| 1917 | 2,687,600 | 34,500 | 467,450 | 2,851,500 | 1,062,700 | 7,924,050 |
| 1918 | 750,000 | | 3,372,165 | 753,000 | 3,851,700 | 15,041,615 |
| 1919 | 525,000 | | 843,000 | 545,000 | | 6,762,800 |
| Total | 7,290,793 | 20,551,838 | 8,811,668 | 66,396,675 | 232,988,274 | 40,905,630 |

OUTPUT OF HATCHERIES OWNED BY THE STATE OF OREGON.

| Year | Chinook fry. | Silverside fry. | Steelhead trout fry. | Sockeye fry. | Total |
|------|-----------------|--------------------|-------------------------|-----------------|------------|
| 1877 | 50,000 | | | | 50,000 |
| 1878 | 79,620 | | | | 79,620 |
| 1879 | 1,876,500 | | | | 1,876,500 |
| 1880 | 1,834,290 | | | | 1,834,290 |
| 1881 | 2,554,290 | | | | 2,554,290 |
| 1888 | 1,300,000 | | | | 1,300,000 |
| 1889 | 4,500,000 | | | | 4,500,000 |
| 1890 | 960,000 | | | | 960,000 |
| 1891 | a 792,000 | | | | 792,000 |
| 1895 | 2,500,000 | | | | 2,500,000 |
| 1896 | 2,500,000 | | | | 2,500,000 |
| 1899 | 2,700,000 | | | | 2,700,000 |
| 1900 | 2,500,000 | | | | 2,500,000 |
| 1901 | 7,562,000 | | 200,000 | | 7,762,000 |
| 1902 | 11,220,550 | 7,957,000 | 245,000 | | 19,422,550 |
| 1903 | 18,502,072 | 3,288,600 | 256,327 | | 22,047,000 |
| 1904 | b 48,730,791 | 3,974,185 | 300,850 | | 52,905,826 |
| 1905 | c 27,393,249 | 5,509,085 | 143,849 | | 33,046,183 |
| 1906 | d 27,404,596 | 7,503,655 | 1,495,735 | | 35,403,986 |
| 1907 | e 25,156,732 | 6,446,628 | 1,859,696 | | 33,463,056 |
| 1908 | f 21,209,394 | 5,359,709 | 376,245 | | 26,945,348 |
| 1909 | 20,108,990 | 9,212,649 | | 1,403,129 | 30,724,768 |

a Eggs from which hatched obtained from U. S. Bureau of Fisheries.

b 6,826,540 eggs obtained from U. S. Bureau of Fisheries.

c 7,714,000 eggs obtained from U. S. Bureau of Fisheries.

d 3,550,000 eggs obtained from U. S. Bureau of Fisheries.

e 3,020,000 eggs obtained from U. S. Bureau of Fisheries.

f 6,581,000 eggs obtained from U. S. Bureau of Fisheries.

OUTPUT OF HATCHERIES OWNED BY THE STATE OF OREGON—Continued.

| Year. | Chinook fry. | Silverside fry. | Steelhead trout fry. | Sockeye fry. | Total. |
|------------|--------------|-----------------|----------------------|--------------|-------------|
| 1910..... | a24,169,365 | 3,631,827 | 2,364,120 | ..... | 30,165,312 |
| 1911..... | b19,762,229 | 4,749,319 | 4,018,598 | c1,488,327 | 30,018,473 |
| 1912..... | d18,077,971 | 9,580,497 | 1,358,742 | e1,957,825 | 30,975,035 |
| 1913..... | e26,623,268 | 9,879,666 | 1,136,031 | f1,937,134 | 39,576,099 |
| 1914..... | g21,945,746 | 5,893,965 | 758,233 | e1,978,140 | 30,576,084 |
| 1915..... | h27,532,168 | 2,917,460 | 4,793,208 | ..... | 35,242,836 |
| 1916..... | i27,120,254 | j4,215,705 | 3,180,709 | k2,399,000 | 36,915,668 |
| 1917..... | 27,615,600 | 4,183,000 | 4,804,743 | l1,526,024 | 38,129,367 |
| 1918..... | 28,109,125 | 4,556,207 | 1,633,580 | m2,731,823 | 37,030,735 |
| 1919..... | 33,732,431 | 9,140,769 | 4,004,754 | n3,199,800 | 50,077,754 |
| Total..... | 475,153,231 | 107,999,926 | 34,333,549 | 17,218,073 | 634,704,779 |

a 6,465,300 eggs obtained from U. S. Bureau of Fisheries.

b 3,950,000 eggs obtained from U. S. Bureau of Fisheries.

c 1,500,000 eggs obtained from U. S. Bureau of Fisheries.

d 8,000,000 eggs obtained from U. S. Bureau of Fisheries.

e 2,000,000 eggs obtained from U. S. Bureau of Fisheries.

f 2,491,000 eggs obtained from U. S. Bureau of Fisheries.

g 1,000,000 eggs obtained from U. S. Bureau of Fisheries.

h Eggs from which hatched obtained from U. S. Bureau of Fisheries.

i All but 490,000 were fingerlings.

j All but 41,500 were fingerlings.

k 3,000,000 eggs obtained from U. S. Bureau of Fisheries.

l Most of the output comprised of fish 4 to 9 months old.

m 3,174,800 from eggs obtained from Alaska, and 25,000 from dwarf sockeye eggs obtained from Montana.

COLUMBIA RIVER AND TRIBUTARIES.

The first fish-cultural work upon the Columbia River and in Oregon was at Clackamas, on the Clackamas River, a tributary of the Willamette River, which empties into the Columbia River about 180 miles from its mouth.

This hatchery was built in 1876 by the Oregon & Washington Fish Propagating Co., which operated it until 1880. In 1887 the State provided for and there was appointed a State fish commission. Almost the first work of the commission was to spend \$12,000 appropriated by the legislature to put in repair and operate this hatchery. On July 1, 1888, it was informally turned over to the United States Commission of Fish and Fisheries, which paid over the purchase price, took formal possession in the following winter, and has operated it ever since, with the exception of several years when the building of dams stopped the progress of salmon to the hatchery. During this period a temporary station for the collection of eggs was established on Sandy River, about 15 miles away, and on Salmon River, a tributary of Sandy River, both tributaries of the Columbia River. Some eggs were also brought in from the California hatcheries and hatched at the Clackamas station. In 1901 the hatchery was moved about 4 miles down the river and has since been operated as both a rearing and a collecting station. In 1901 the State established another hatchery on the Clackamas River about 30 miles below the main station and between the north and south forks. In 1904 all were turned over to the United States. In 1915 the hatchery was moved again. In 1907 an experimental station for the collection of eggs of the early variety of chinook salmon was established by the State of Oregon on the Clackamas River below the Portland Railway, Light & Power Co.'s dam at Cazadero, but this was later operated by the United States Bureau of Fisheries. The building of a dam having cut off this station, another was established in 1913 at a point 30 miles distant from Portland.

In 1889 the State established a hatchery in the cannery of F. M. Warren, at Warrendale, in Multnomah County, on the Columbia River, which was operated in that year and in 1890.

In 1895 some of the Oregon salmon packers combined and organized the Columbia River Packers' Propagating Co., which established a hatchery on the upper Clackamas River at the junction of the Warm Springs and the Clackamas and operated it in 1895 and 1896. The Government operated it in 1897 and 1898, after which it was turned over to the State and moved to the opposite side of the river.

In 1898 the collection of steelhead-trout eggs was first undertaken on the northwest coast by the State of Oregon on Salmon River, a tributary of the Columbia River, and met with fair success. In March, 1899, the Government sent a party to the falls of the Willamette River, near Oregon City, to collect steelhead eggs, and also operated for this purpose at its substation on the Salmon River, but the latter effort met with failure, as the rack was washed away. This station was turned over to the State on June 15, 1899.

In 1901 the State of Oregon did some experimental work at Swan Falls, on Snake River, the boundary for a considerable distance between Oregon and Idaho. During the winter and early spring of 1902 the State also worked Tucannon River, which is a tributary of Snake River, for steelhead, but met with poor success. Snake River was worked again in 1902 at the foot of Morton Island, which is situated 2 miles above Ontario, in Malheur County. Title to the necessary property was secured from the War Department in 1903 and permanent buildings were erected. It was closed for some years and finally abandoned in 1911.

In 1901 the State of Oregon established an experimental hatchery in Wallowa County, on the Grande Ronde River, at the mouth of a small tributary called the Wenaha River, which enters the main stream about 50 miles from its mouth. A permanent station was established in the canyon about $1\frac{1}{2}$ miles below the Wallowa bridge on the Wallowa River, a tributary of the Grande Ronde River, in 1903.

In 1902 the State of Oregon erected a permanent plant on Salmon River at its junction with Boulder Creek. This plant was closed in 1911.

In the same year the State established an experimental station on the McKenzie River, a tributary of the Willamette River, about one-half mile above Vida post office. This experimental work was resumed in 1905 at a point 2 miles below Gate Creek. The hatchery was permanently established at a spot about 30 miles from Eugene and near the town of Leaburg a year or two later.

In 1903 a hatchery was built by the State of Oregon on the Snake River near the town of Ontario, in eastern Oregon.

In 1906 an experimental station was established by the State on Breitenbush Creek, a short distance above its junction with the Santiam River, a tributary of the Willamette River, but the plant was destroyed, very shortly after its establishment, by a forest fire. An experimental station was reestablished here in 1909, but a heavy freshet raised the river so high that the penned fish escaped around the rack.

In 1909 the State of Oregon built at Bonneville, on Tanner Creek, a tributary of the Columbia River, a large central hatchery capable of handling 60,000,000 eggs, it being the intention of the State to hatch at this plant the eggs collected at other stations.

In the same year a temporary hatchery was located on the Santiam River by the State of Oregon.

During 1910 the State of Oregon received 1,500,000 red salmon eggs from the Yes Bay (Alaska) hatchery of the United States Bureau of Fisheries, and yearly since they have received a consignment from the same source, as will be noted in the statistical tables. These were hatched out in the Bonneville hatchery and planted in the Columbia River.

The State of Oregon built a hatchery on the Klaskanine River, a tributary of Youngs River, near Olney, in Clatsop County, in 1911. In the same year an eyeing station for spring chinooks was opened by the State on the Willamette River, near Lowell.

The first entrance of Washington (then a Territory) into fish-cultural operations was in 1879, when the State fish commissioner paid the Oregon & Washington Fish Propagating Co., which was operating the hatchery on the Clackamas River, \$2,000 for salmon fry deposited in that river. In 1893 the State legislature established a hatchery fund which was to be supplied by licenses from certain lines of the fishery business. In 1895 its first hatchery in the Columbia River Basin was built on the Kalama River, about 4 miles distant from its junction with the Columbia, and in Cowlitz County. Shortly after this hatchery was built it was discovered that it was above where the salmon spawned, and a second hatchery was built $1\frac{1}{2}$ miles below the first named, as the rugged mountainous character of the country made transportation between the two sites difficult. Of recent years a road has been constructed along the river bank, and it is probable that the upper buildings will be abandoned entirely.

Another station for the collection and eyeing of eggs was established on the Chinook River, a small stream which empties into Baker Bay near the mouth of the Columbia.

During the fiscal year 1897 the United States Fish Commission established a station on Little White Salmon River, a stream which empties into the Columbia, on the Washington side, about 14 miles above the Cascades. During the fiscal year 1901 an auxiliary station was operated on Big White Salmon River, while fishing was carried on in Eagle and Tanner Creeks, in Oregon, the eggs obtained from these creeks being brought to the Little White Salmon hatchery.

In 1899 the State of Washington built and operated hatcheries on the Wenatchee River, a tributary of the Columbia River, about $1\frac{1}{2}$ miles from Chiwaukum Station on the Great Northern Railway, and on Wind River, a tributary of the Columbia, about 1 mile from the junction.

In 1900 Washington State hatcheries were established in the Columbia River Basin as follows: White River hatchery, which was built on Coos Creek, which empties into a tributary of the White River, the location being about $2\frac{1}{2}$ miles from where the Green River joins the White River; Methow River hatchery, built on the Methow River at the point where it is joined by the Twisp, about 22 miles from the Columbia River; Colville River hatchery, built

on the north bank of Colville River, about 1½ miles from its mouth, and about 1 mile from Kettle Falls; Klickitat River hatchery, located on the east bank of the Klickitat River, about 6 miles from its mouth; and one on the Little Spokane River, about 10 miles from its mouth and about 9 miles north of the city of Spokane. The Klickitat River hatchery never was operated, while most of the others were operated intermittently.

In 1906 a hatchery was established by the State of Washington on the Lewis River, some distance above the town of Woodland. In 1919 this hatchery was operated by the United States Bureau of Fisheries.

In 1909 the State of Washington established a hatchery near Pateros, on the Methow River, a tributary of the Columbia River, and on the Tilton.

In 1915 Clarke County, Wash., built a hatchery on the east side of Cold Creek, about 2 miles from the town of Vancouver.

A temporary station was established by the State of Washington on Wenatchee Lake, near Leavenworth, in 1915.

The following table shows the plants of salmon and steelhead trout in the Columbia River and its tributaries by the Bureau of Fisheries and the States of Oregon and Washington:

PLANTS OF SALMON IN THE COLUMBIA RIVER AND TRIBUTARIES SINCE 1877.

| Year ending June 30— | Sockeye. | | Chinook. | | Silverside. | |
|----------------------|------------|-------------------------------------|---------------|-------------------------------------|-------------|-------------------------------------|
| | Fry. | Yearlings, fingerlings, and adults. | Fry. | Yearlings, fingerlings, and adults. | Fry. | Yearlings, fingerlings, and adults. |
| 1877..... | | | 300,000 | | | |
| 1878..... | | | 79,620 | | | |
| 1879..... | | | 3,076,500 | | | |
| 1880..... | | | 1,834,200 | | | |
| 1881..... | | | 2,554,200 | | | |
| 1888..... | | | 1,300,000 | | | |
| 1889..... | | | 4,500,000 | | | |
| 1890..... | | | 3,756,475 | | | |
| 1891..... | | | 5,694,000 | | | |
| 1892..... | | | 1,332,400 | | | |
| 1893..... | | | 4,100,000 | | | |
| 1894..... | | | 213,000 | | | |
| 1895..... | | | 22,522,000 | | | |
| 1896..... | | | 9,832,150 | 557,150 | | |
| 1897..... | | | 10,641,394 | | | |
| 1898..... | | | 26,212,074 | | | |
| 1899..... | | | 19,979,241 | | | |
| 1900..... | | | 22,510,869 | | 7,175,824 | |
| 1901..... | | | 24,977,310 | 1,668 | 5,559,750 | |
| 1902..... | | | 44,328,085 | | 17,545,724 | |
| 1903..... | | | 40,174,313 | | 8,721,720 | |
| 1904..... | | | 71,694,587 | | 8,422,085 | |
| 1905..... | | | 17,107,217 | | 1,354,610 | |
| 1906..... | | | 836,324,805 | 47,980 | 828,472 | 300 |
| 1907..... | | | 23,171,235 | | 2,657,349 | |
| 1908..... | | | 32,856,262 | 1,995,746 | 1,705,543 | |
| 1909..... | | | 33,081,994 | 16,949 | 2,439,415 | |
| 1910..... | | | 37,743,777 | 225 | 3,374,733 | |
| 1911..... | 1,488,327 | | 28,791,095 | 11,700 | 21,308,900 | |
| 1912..... | 1,957,825 | | 49,335,065 | 1,405,860 | 1,243,660 | |
| 1913..... | 1,937,134 | | 70,211,177 | | 4,591,500 | |
| 1914..... | 1,978,140 | | 81,995,039 | 1,732,805 | 636,900 | |
| 1915..... | | | 81,504,641 | 812,801 | 608,747 | |
| 1916..... | 4,478,362 | 1,526,024 | 85,637,635 | 8,686,789 | 873,882 | |
| 1917..... | 1,526,024 | | 47,187,410 | 9,922,869 | 1,381,915 | 86,100 |
| 1918..... | 2,731,823 | | 64,929,898 | 10,383,400 | 3,763,832 | 18,800 |
| 1919..... | 3,199,800 | 939,960 | 22,571,500 | 46,382,420 | 4,205,864 | 2,200 |
| Total..... | 19,297,435 | 2,465,984 | 1,014,082,348 | 81,958,362 | 78,400,425 | 107,400 |

^a Includes 23,000 eggs.
^b Includes 48,200 eggs.

^c Includes 100,000 eggs.
^d Includes 1,000,000 eggs.

PLANTS OF SALMON IN THE COLUMBIA RIVER AND TRIBUTARIES SINCE 1877—Contd.

| Year ending June 30— | Steelhead trout. | | Chum. | | Total. | |
|----------------------|------------------|---|------------|---|---------------|---|
| | Fry. | Yearlings, fingerlings, and adults. | Fry. | Yearlings, fingerlings, and adults. | Fry. | Yearlings, fingerlings, and adults. |
| 1877..... | | | | | 300,000 | |
| 1878..... | | | | | 79,020 | |
| 1879..... | | | | | 3,076,500 | |
| 1880..... | | | | | 1,834,290 | |
| 1881..... | | | | | 2,554,290 | |
| 1882..... | | | | | 1,300,000 | |
| 1883..... | | | | | 4,500,000 | |
| 1884..... | | | | | 3,756,475 | |
| 1885..... | | | | | 5,694,000 | |
| 1886..... | | | | | 1,332,400 | |
| 1887..... | | | | | 4,100,000 | |
| 1888..... | | | | | 213,000 | |
| 1889..... | | | | | 2,523,000 | |
| 1890..... | | | | | 9,832,150 | 557,150 |
| 1891..... | | | | | 10,641,394 | |
| 1892..... | | | | | 26,212,074 | |
| 1893..... | 8,025 | | | | 19,987,866 | |
| 1894..... | 299,000 | | | | 29,985,093 | |
| 1895..... | 245,000 | | | | 30,782,060 | 1,668 |
| 1896..... | 259,827 | | | | 62,130,136 | |
| 1897..... | 563,550 | 37,033 | | | 49,459,583 | 37,033 |
| 1898..... | 158,981 | | | | 80,275,653 | |
| 1899..... | 6768,225 | | | | 19,230,062 | |
| 1900..... | 21,745,111 | 24,389 | | | 38,898,388 | 72,663 |
| 1901..... | 29,640 | | | | 25,855,224 | |
| 1902..... | 15,000 | | | | 34,576,805 | 1,995,746 |
| 1903..... | 61,658,657 | | | | 36,580,066 | 16,949 |
| 1904..... | 22,062,688 | | | | 43,182,198 | 225 |
| 1905..... | 1,982,331 | | 420,730 | | 33,991,383 | 11,700 |
| 1906..... | 1,387,500 | 116,300 | 106,020 | | 54,030,070 | 1,522,160 |
| 1907..... | 40,000 | | 105,800 | | 76,885,611 | |
| 1908..... | 2932,700 | | 591,628 | | 86,134,417 | 1,732,805 |
| 1909..... | 4,128,833 | | 8,299,572 | | 94,541,793 | 812,801 |
| 1910..... | 1,459,067 | 6,000 | 16,448,109 | | 108,917,145 | 10,218,813 |
| 1911..... | 4,074,330 | 338,850 | 5,332,125 | 248,050 | 59,501,804 | 10,595,869 |
| 1912..... | 4,274,330 | | 8,881,640 | | 84,581,523 | 10,402,200 |
| 1913..... | 4,663,820 | 135,500 | 210,600 | 460,800 | 34,851,584 | 47,920,880 |
| Total..... | 30,151,725 | 658,096 | 40,396,324 | 708,850 | 1,182,328,257 | 85,898,692 |

a Includes 50,000 eggs.

b Includes 58,000 eggs.

c Includes 25,000 eggs.

d Includes 79,000 eggs.

WASHINGTON.

Willapa River.—In 1899 Washington established a hatchery on Trap Creek, a tributary of the Willapa River, situated about 200 yards from the creek's mouth.

In 1916 local residents along the North River, a tributary of Willapa Harbor, contributed the funds to build a salmon hatchery, and this was constructed and put into operation the same year.

In 1917 a salmon hatchery was built and put into operation at Raymond. It is designated as Willapa Hatchery No. 2.

In 1918 some fishermen and public-spirited citizens of this section contributed the money for the building of a State hatchery on the Nasel River, a tributary of Willapa Harbor.

Chehalis River.—The construction of a hatchery on the Chehalis River, about 4 miles above the city of Montesano, was begun by the State in October, 1897, but owing to bad weather and extreme high water was not completed until late in 1898. The hatchery was a failure until 1902 when a fair season was had, as was again true in 1903. It was not operated in 1904. Since the State began taking

eggs from the Satsop River, a tributary of the Chehalis, it has been possible to fill the hatchery each season.

In 1909 the site where eggs had been gathered on the Satsop River was purchased, and a new hatchery was erected there. It has three concrete rearing ponds and is fully equipped for the taking of spawn and the hatching out and caring for 5,000,000 fry. This plant was first operated in the fall of 1909.

Work was begun in September, 1914, by the United States Bureau of Fisheries on a hatching station on Lake Quinault, Wash., and a take of eggs was made the same year.

In lieu of installing fishways in their dams in the Humptulips River and tributaries, in the Grays Harbor section, two timber firms agreed to furnish the money needed to build a hatchery on Stevens Creek, west of Humptulips, and the same was constructed and put into operation in October of 1914. The plant is now the property of the State.

In 1917 a hatchery was built by the State on Chehalis River near Dryad, with money contributed by two lumber companies in lieu of building fishway over a dam.

Puget Sound and tributaries.—In 1896 the State established a hatchery on Baker Lake, which is the head of Baker River, a tributary of the Skagit River, and this was the first establishment for the hatching of sockeye salmon. In July, 1899, it was sold to the United States Fish Commission. In 1901 steelhead trout eggs were collected on Phinney Creek, about 5 miles from the town of Birdsvew, and some 30 miles from Baker Lake. In 1901 an auxiliary station was opened at Birdsvew, on Skagit River, and steelhead trout eggs were collected on Phinney and Grandy Creeks and brought to Baker Lake to be hatched.

In 1898 a private hatchery (the necessary money being raised by subscription among the residents of Fairhaven, now Bellingham, and vicinity) was built near Lake Samish, a few miles from Fairhaven.

In 1899 a hatchery was built by the State on Kendall Creek, a tributary of the Nooksack River, about 300 yards from same, and about 2 miles from the railway station of Kendall. Except in 1903, this hatchery has since been operated continuously. An eyeing station was built in 1907 on the south fork of the Nooksack River, about 1 mile from Acme. This hatchery is now used as a reserve station.

In the same year the State built a hatchery on the Skokomish River, about 4 miles from its mouth. An eyeing station was also erected on the north fork of the same river. The main station was not operated in 1904 and only on a small scale in 1903 and 1905.

The State in 1889 built a hatchery on Friday Creek, a tributary of the Samish River, situated about 1 mile from the mouth of the creek.

The following State hatcheries were first operated in 1900: Snohomish hatchery, built on the west bank of Skykomish River, a few miles from its mouth; Nisqually River hatchery, built on Muck Creek, about one-half mile from the Nisqually River, and about 4 miles from the town of Roy, in Pierce County; and the Stillaguamish hatchery, located on the Stillaguamish River, about 4 miles from the town of Arlington, in Snohomish County. The latter has since been moved to Jim Creek, a tributary of the south branch of the Stillaguamish River. It is merely used as an eyeing station now.

The Startup hatchery, located near Startup, on the Skykomish River, was formerly used as a collecting station for the Snohomish hatchery. It is still used for this purpose, but also retains and hatches a considerable quantity of spawn. The station is about 4 miles from the Snohomish hatchery. In 1918 it was rebuilt and now bears the name of Skykomish hatchery.

In 1900 the State established a fisheries experimental station at Keyport Landing, on the east arm of Port Orchard Bay, with Pearson as the nearest post office. The work of the station was devoted to salmon and oysters until it was abandoned a few years later.

The State established a hatchery on the Dungeness River, about 7 miles from the town of Dungeness, in Clallam County, in 1901. In 1906 it constructed a hatchery on a small tributary of the Skagit River, between Hamilton and Lyman. This was destroyed in 1917 by floods. The station built on Sauk River, a tributary of the Skagit, has been operated only occasionally since the Skagit hatchery was built.

The White River hatchery was constructed on Suice Creek, a tributary of Green River, some years ago. During the summer of 1909 a new hatchery was built at this station, the old one being too small to accommodate the amount of spawn that could be taken. The new hatchery is located on the east side of Suice Creek near the county road. The building contains 140 hatching troughs. The plant has a pond system, where the fry are kept and fed until they are able to shift for themselves.

During the summer of 1911 the city of Tacoma constructed a large concrete dam in the Green River, about 4 miles west of Eagle Gorge. As this dam prevented the salmon from reaching the spawning beds, the State established an eyeing station the same year just below the dam. In 1913 the name was changed to Green River hatchery, to conform to the name of the main stream.

In 1912 the United States Bureau of Fisheries completed the Quilcene and Duckabush hatcheries. Both are on small tributaries entering the west side of Hoods Canal, an arm of Puget Sound.

In 1913 a new station was operated by the Bureau on the Dusewallips River, a tributary of Hoods Canal, Puget Sound, near Brinnon. Two new field stations—on Elwell River, a tributary of the Skykomish River, near Sultan, and on Sauk River, a tributary of the Skagit River, near Darrington—were also put into operation the same year. The Sauk River had been worked by the State at one time.

In 1913 the Middle Fork Nooksak eyeing station was transformed into a hatchery. In the same year the eyeing station on the south fork was moved farther up the river.

In 1914 stations were established by the United States Bureau of Fisheries on Day Creek and Illabot Creek, tributaries of the Skagit River, while a substation was opened on Hamahama River at Eldon, distant about 9 miles up Hood Canal from the mouth of the Duckabush River.

On May 23, 1914, the Baker Lake hatchery building was destroyed by fire. In addition to the building and equipment, 1,305,820 silver fry and 823,097 sockeye fry were destroyed. The station was rebuilt but was burned down again in 1919. It has since been rebuilt.

In 1915 the State built a hatchery on the Pilchuck River, a tributary of the Skykomish River, near Granite Falls.

In lieu of building a fishway in its dam on the Elwha River, near Port Angeles, the Olympic Power Co. furnished the funds needed to build a hatchery below the dam, and this was opened by the State in 1915.

In 1916 the city of Tacoma furnished funds to build a hatchery in lieu of a fish ladder over the Nisqually power plant dam, and the hatchery was constructed by the State at Chambers Prairie and opened in 1916. It is known as the Chambers Creek hatchery.

In 1917 a new hatchery was established by the State at Orting, on the Puyallup River, while in 1918 an eyeing station was established at Tahuya, on Hoods Canal, near the Skokomish hatchery.

In 1919 the Nisqually hatchery was destroyed by floods.

The following tables show the total output of the salmon hatcheries in the State of Washington owned by the United States Bureau of Fisheries and the hatcheries owned by the State itself:

OUTPUT OF THE SALMON HATCHERIES IN WASHINGTON OWNED BY THE U. S. BUREAU OF FISHERIES.

| Year ending June 30— | Chinook. | | | Sockeye, or blueback. | | | Silver, or coho. | | |
|----------------------|------------|-------------|-------------------------------------|-----------------------|-------------|-------------------------------------|------------------|-------------|-------------------------------------|
| | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
| 1897 | | 1,848,760 | | | | | | | |
| 1898 | | 7,391,886 | | | | | | | |
| 1899 | 4,926,000 | 1,791,056 | | | | | | | |
| 1900 | 2,686,000 | 6,626,947 | | | 10,683,000 | | | | |
| 1901 | 6,581,000 | 5,427,680 | | | 3,834,453 | | | 174,041 | |
| 1902 | | 15,637,687 | | | 3,371,000 | | | | |
| 1903 | | 16,774,030 | | | 3,731,789 | | | 81,812 | |
| 1904 | 7,506,000 | 17,386,183 | | | 3,855,000 | | | 3,984,645 | |
| 1905 | | 4,236,276 | | | 7,819,281 | 10,000 | 107,000 | 8,071,081 | |
| 1906 | 7,714,000 | 14,846,905 | | 880,000 | 3,285,130 | 9,500 | 239,180 | 6,445,574 | |
| 1907 | 3,550,000 | 6,512,738 | | | 4,224,255 | | 760,000 | 3,636,952 | |
| 1908 | 1,485,000 | 12,372,503 | 1,537,941 | 75,000 | 8,514,305 | | 296,000 | 13,262,714 | |
| 1909 | 3,650,000 | 11,565,553 | 14,186 | 100,000 | 5,430,626 | | 272,000 | 7,661,110 | |
| 1910 | 3,813,250 | 9,175,610 | | | 4,554,825 | | 275,000 | 10,888,025 | |
| 1911 | 3,350,000 | 7,307,455 | 11,700 | | 5,496,000 | | 102,000 | 4,550,615 | |
| 1912 | 8,020,000 | 10,959,728 | 655,095 | | 4,692,573 | | 52,000 | 10,599,939 | |
| 1913 | 19,713,000 | 19,933,300 | | | 5,751,700 | | 102,000 | 10,754,617 | |
| 1914 | 4,584,000 | 31,140,440 | 1,130,505 | 50,000 | 2,583,469 | 120,000 | | 13,591,354 | |
| 1915 | 4,998,000 | 38,162,139 | 987,495 | 155,000 | 10,820,441 | 46,575 | 35,000 | 20,673,056 | 41,500 |
| 1916 | | 38,012,864 | 7,488,270 | | 15,737,420 | 2,666,308 | 2,500 | 5,466,334 | 1,460,354 |
| 1917 | | 14,969,904 | 5,865,226 | | 11,861,825 | 2,145,953 | | 3,960,000 | 4,559,860 |
| 1918 | 3,150,000 | 2,185,218 | 41,202,694 | | 3,625,000 | 12,705,285 | | 972,300 | 10,118,815 |
| 1919 | 960,000 | 389,002 | 18,474,900 | | 1,000,000 | 15,799,960 | | 7,544,020 | 697,380 |
| Total. | 86,086,250 | 294,653,864 | 77,368,012 | 1,260,000 | 120,872,092 | 33,503,581 | 2,242,680 | 132,318,189 | 16,877,909 |

OUTPUT OF THE SALMON HATCHERIES IN WASHINGTON OWNED BY THE U. S. BUREAU OF FISHERIES—Continued.

| Year ending June 30— | Humpback. | | | Steelhead trout. | | |
|----------------------|------------|------------|-------------------------------------|------------------|------------|-------------------------------------|
| | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
| 1900 | | | | | 26,000 | |
| 1902 | | | | | 110,000 | |
| 1903 | | | | 80,000 | 440,000 | 223,815 |
| 1904 | | 176,597 | | 255,000 | 70,000 | |
| 1905 | | | | 414,400 | 3,205 | |
| 1906 | 2,000 | 969,900 | | 348,000 | 540,000 | |
| 1907 | | | | 200,000 | 941,505 | |
| 1908 | 502,000 | 6,764,762 | | 224,000 | 136,916 | |
| 1909 | | | | 229,000 | 717,691 | |
| 1910 | | 1,368,000 | | 300,000 | 1,437,038 | |
| 1911 | | 96,000 | | 600,000 | 911,650 | |
| 1912 | | 2,566,325 | | 905,000 | 2,284,315 | |
| 1913 | | 1,880 | | 1,330,000 | 1,477,150 | |
| 1914 | 13,269,000 | 21,114,023 | 4,355 | 729,000 | 1,792,430 | |
| 1915 | | 6,929,500 | | 125,000 | 2,008,698 | 137,665 |
| 1916 | 7,000,000 | 6,106,400 | 2,915,000 | 1,040,000 | 341,600 | 891,000 |
| 1917 | | 165,000 | 7,449,630 | 550,000 | 1,979,010 | 1,421,000 |
| 1918 | | 2,132,831 | 3,736,000 | 320,000 | 103,000 | 3,482,620 |
| 1919 | | 2,354,500 | 369,958 | 250,000 | | 305,000 |
| Total | 20,764,000 | 50,745,808 | 14,174,343 | 7,950,400 | 15,320,208 | 6,464,100 |

| Year ending June 30— | Chum. | | Total. | | |
|----------------------|-------------|-------------------------------------|-------------|-------------|-------------------------------------|
| | Fry. | Fingerlings, yearlings, and adults. | Eggs. | Fry. | Fingerlings, yearlings, and adults. |
| 1897 | | | | 1,848,760 | |
| 1898 | | | | 7,301,886 | |
| 1899 | | | 1,926,000 | 1,791,056 | |
| 1900 | | | 2,686,000 | 17,335,947 | |
| 1901 | | | 6,581,000 | 9,434,174 | |
| 1902 | | | | 19,118,687 | |
| 1903 | | | 80,000 | 21,027,631 | 223,815 |
| 1904 | | | 7,761,000 | 25,472,425 | |
| 1905 | | | 521,400 | 20,129,843 | 10,000 |
| 1906 | | | 9,184,180 | 26,087,599 | 9,500 |
| 1907 | | | 4,510,000 | 15,315,450 | |
| 1908 | | | 2,582,000 | 41,051,200 | 1,537,941 |
| 1909 | | | 4,242,000 | 25,374,980 | 14,186 |
| 1910 | | | 4,388,250 | 27,423,498 | |
| 1911 | 69,000 | | 4,112,000 | 18,430,720 | |
| 1912 | 2,495,000 | | 8,977,000 | 33,597,880 | 11,700 |
| 1913 | 19,470,000 | | 21,145,000 | 57,397,647 | 655,095 |
| 1914 | 8,672,735 | | 18,623,000 | 78,894,451 | 1,251,860 |
| 1915 | 35,504,707 | | 5,313,000 | 114,098,541 | 1,213,235 |
| 1916 | 21,500,944 | 1,000,000 | 8,042,500 | 87,165,562 | 16,420,932 |
| 1917 | 14,403,390 | 7,014,589 | 550,000 | 17,332,039 | 28,458,649 |
| 1918 | 9,892,145 | | 3,470,000 | 18,910,494 | 71,245,414 |
| 1919 | 4,544,000 | 4,524,560 | 1,210,000 | 15,831,522 | 40,171,758 |
| Total | 116,560,831 | 12,539,140 | 118,903,330 | 730,470,992 | 161,227,085 |

OUTPUT OF THE SALMON HATCHERIES OWNED BY THE STATE OF WASHINGTON.^a

| Year ending June 30— | Chinook fry. | Chum fry. | Hump- back fry. | Silver, or coho, fry. | Sockeye, or blue- back, fry. | Steelhead- trout fry. | Total. |
|-------------------------|-----------------|-------------|--------------------|--------------------------|------------------------------------|--------------------------|---------------|
| 1896..... | 4,500,000 | | | | | | 4,500,000 |
| 1897..... | 4,050,000 | | | | 5,500,000 | | 9,550,000 |
| 1898..... | 4,275,000 | | | | 5,400,000 | | 9,675,000 |
| 1899..... | 8,595,000 | | | 189,000 | | | 8,784,000 |
| 1900..... | 12,251,600 | 10,301,760 | | 13,778,280 | | 1,736,560 | 38,068,200 |
| 1901..... | 12,275,400 | 16,478,280 | | 19,747,894 | | 1,398,476 | 49,900,050 |
| 1902..... | 14,766,822 | 9,937,390 | | 32,964,593 | | 2,481,371 | 60,150,176 |
| 1903..... | 14,283,499 | 9,937,390 | | 28,659,079 | | 3,134,076 | 56,014,044 |
| 1904..... | 13,261,184 | | 295,200 | 15,725,196 | | 3,868,866 | 33,150,446 |
| 1905..... | 7,101,180 | | | 12,226,294 | | 2,433,635 | 21,761,109 |
| 1906..... | 10,943,550 | 3,268,800 | | 28,906,380 | | 2,769,784 | 45,888,514 |
| 1907..... | 8,897,670 | 6,120,000 | | 28,668,600 | | 3,575,943 | 47,262,213 |
| 1908..... | 18,647,600 | 4,342,350 | 2,655,900 | 29,273,202 | | 4,578,075 | 59,497,127 |
| 1909..... | 17,440,950 | 8,218,000 | | 24,543,200 | | 4,080,450 | 54,282,600 |
| 1910..... | 21,168,350 | 8,607,500 | 519,000 | 30,894,100 | | 4,855,000 | 66,044,550 |
| 1911..... | 16,458,502 | 13,326,750 | | 33,097,750 | | 5,163,180 | 68,046,182 |
| 1912..... | 23,380,516 | 4,684,950 | 370,785 | 37,164,125 | | 4,832,067 | 70,432,443 |
| 1913..... | 30,542,928 | 14,711,400 | | 50,263,290 | | 9,089,250 | 104,606,868 |
| 1914..... | 35,529,709 | 7,842,266 | 1,532,737 | 33,494,380 | 49,792 | 3,601,514 | 82,050,398 |
| 1915 <i>b</i> | 639,784,092 | 27,458,665 | 578,504 | 60,169,474 | 62,631 | 3,457,130 | 131,510,496 |
| 1916 <i>d</i> | 48,239,092 | 41,890,354 | 5,902,227 | 38,877,396 | 607,079 | 9,984,852 | 145,501,900 |
| 1917 <i>e</i> | 34,228,979 | 15,086,648 | | 5,842,775 | 808,455 | | 55,966,857 |
| 1918 <i>f</i> | 83,175,074 | 71,750,001 | 6,086,256 | 45,660,603 | ø 6,571,770 | 10,250,532 | 223,494,236 |
| 1919 <i>f</i> | 45,773,506 | 22,228,025 | | 16,220,087 | 645,520 | 7,993,452 | 92,860,590 |
| Total..... | 529,570,203 | 296,100,529 | 17,941,209 | 586,365,698 | 19,646,147 | 89,294,213 | 1,538,997,999 |

^a As the printed reports of the State before 1913 in many instances report as the output the number of eggs gathered, it has been necessary in such cases to make an arbitrary reduction from these figures, in order to allow for the loss in the egg stage. In addition to figures in table, in 1916, 13,424,362; in 1918, 6,745,823; and in 1919, 12,351,780 dwarf sockeye were hatched and planted in waters of the State.

^b A considerable proportion of the fry was fed in rearing ponds for some time before planting.

^c 29,900 eggs were distributed in addition.

^d Year ends Nov. 30, 1916.

^e Period from Nov. 30, 1916, to Mar. 31, 1917.

^f Year ending Mar. 31.

^ø In addition 5,000,000 eggs were furnished by the U. S. Bureau of Fisheries.

The following table shows the plantings made in waters of Washington other than the Columbia River by the United States Bureau of Fisheries and the State of Washington:

PLANTS OF SALMON IN THE WATERS OF WASHINGTON OTHER THAN THE COLUMBIA RIVER.

| Year ending June 30— | Puget Sound and tributaries. | | | | | |
|----------------------|------------------------------|------------------------------------|------------------------|------------------------------------|------------------|------------------------------------|
| | Chinook. | | Sockeye. | | Silver, or coho. | |
| | Fry. | Yearlings, fingerlings, or adults. | Fry. | Yearlings, fingerlings, or adults. | Fry. | Yearlings, fingerlings, or adults. |
| 1897..... | | | 5,500,000 | | | |
| 1898..... | | | 5,400,000 | | | |
| 1899..... | 7,470,000 | | | 189,000 | | |
| 1900..... | | | 10,683,000 | 6,749,280 | | |
| 1901..... | 300,000 | | 3,831,453 | 14,360,185 | | |
| 1902..... | 2,141,322 | | 3,371,000 | 23,161,069 | | |
| 1903..... | 2,113,850 | | 3,731,789 | 21,507,771 | | |
| 1904..... | 1,865,933 | | 3,855,000 | 14,071,845 | | |
| 1905..... | 2,590,728 | | | 16,441,375 | | |
| 1906..... | 4,819,290 | | 3,573,130 | 9,500 | | 14,840 |
| 1907..... | 3,907,598 | | | 29,755,574 | | |
| 1908..... | 8,356,709 | | 8,514,305 | 26,960,552 | | |
| 1909..... | 9,647,288 | | 5,450,626 | 37,613,466 | | |
| 1910..... | 11,681,060 | | 4,554,825 | 28,622,310 | | |
| 1911..... | 4,984,182 | | 5,496,000 | 36,837,125 | | |
| 1912..... | 4,646,254 | | 4,692,573 | 29,941,865 | | |
| 1913..... | 7,561,328 | | 5,751,700 | 39,788,614 | | |
| 1914..... | 7,392,826 | | ^a 2,683,261 | 56,128,207 | | |
| 1915..... | 15,222,734 | | ^b 7,371,056 | 42,213,911 | | |
| 1916..... | 22,022,439 | 802,795 | 1,897,420 | 74,505,147 | | |
| 1917..... | 26,890,383 | 750,612 | 1,520,280 | 42,696,932 | | 1,455,490 |
| 1918..... | 35,318,396 | 411,060 | 7,696,750 | 2,063,000 | | 4,500,460 |
| 1919..... | 22,244,102 | 195,900 | 645,520 | 9,319,275 | | 6,845,115 |
| Total..... | 201,176,702 | 2,160,367 | 96,202,688 | 20,164,295 | 589,306,935 | 15,740,885 |

^a Includes 50,000 eggs.

^b All fingerlings.

PLANTS OF SALMON IN THE WATERS OF WASHINGTON OTHER THAN THE COLUMBIA RIVER—Continued.

| Year ending June 30— | Puget Sound and tributaries. | | | | | |
|----------------------|------------------------------|------------------------------------|-------------|------------------------------------|------------------------|------------------------------------|
| | Humpback. | | Chum. | | Steelhead. | |
| | Fry. | Yearlings, fingerlings, or adults. | Fry. | Yearlings, fingerlings, or adults. | Fry. | Yearlings, fingerlings, or adults. |
| 1900. | | | 10,301,760 | | 1,572,560 | |
| 1901. | | | 16,478,280 | | 1,398,476 | |
| 1902. | | | 9,937,390 | | 2,591,371 | |
| 1903. | | | 9,937,390 | | 3,107,891 | 218,200 |
| 1904. | 471,797 | | | | 3,518,476 | |
| 1905. | | | | | ^a 1,329,940 | |
| 1906. | 969,990 | | 1,800,000 | | 3,162,174 | 15,000 |
| 1907. | 4,224,255 | | 5,220,000 | | 3,964,308 | |
| 1908. | 9,420,662 | | 2,378,350 | | 4,586,491 | |
| 1909. | | | 6,048,000 | | ^b 4,499,141 | |
| 1910. | 1,887,600 | | 7,748,500 | | 6,292,358 | |
| 1911. | 96,000 | | 12,074,060 | | 4,841,330 | |
| 1912. | 5,432,110 | | 3,526,170 | | ^c 6,732,805 | 1,000 |
| 1913. | 1,888 | | 31,408,960 | | 9,731,400 | |
| 1914. | 22,647,060 | ^d 4,335 | 15,535,046 | | 4,444,271 | |
| 1915. | 7,508,004 | | 51,852,050 | | 4,925,555 | |
| 1916. | 12,005,627 | 2,618,000 | 41,541,949 | 1,000,000 | 5,102,566 | 891,000 |
| 1917. | 165,000 | 7,449,030 | 12,955,800 | 6,766,530 | 1,979,010 | 1,420,500 |
| 1918. | 8,219,086 | 4,796,000 | 52,674,752 | | 4,851,092 | 3,520,420 |
| 1919. | 2,354,000 | 309,958 | 21,480,325 | 4,003,760 | 3,152,452 | |
| Total. | 75,403,079 | 15,477,343 | 312,798,782 | 11,830,290 | 81,763,647 | 6,066,120 |

| Year ending June 30— | Quinalt Lake and River. | | | | | |
|----------------------|-------------------------|------------------------------------|------------|------------------------------------|-------------|------------------------------------|
| | Chinook. | | Sockeye. | | Silverside. | |
| | Fry. | Yearlings, fingerlings, or adults. | Fry. | Yearlings, fingerlings, or adults. | Fry. | Yearlings, fingerlings, or adults. |
| 1915. | 19,913 | | 3,558,591 | | 198,966 | |
| 1916. | 29,600 | 4,810 | 13,840,000 | 2,665,788 | 96,650 | 4,864 |
| 1917. | 160,000 | | 11,150,000 | 52,953 | 1,910,000 | |
| 1918. | 220,000 | | 2,500,000 | 3,386,010 | 200,000 | 3,303,700 |
| 1919. | 100,000 | 109,400 | 1,000,000 | 4,738,000 | 600,000 | 419,400 |
| Total. | 529,513 | 114,210 | 32,048,591 | 10,842,751 | 3,005,616 | 3,727,064 |

| Year ending June 30— | Chehalis River. | | | | Willapa River. | | | |
|----------------------|-----------------|------------------|------------|------------|----------------|------------------|-----------|------------|
| | Chinook. | Silver, or coho. | Chum. | Steelhead. | Chinook. | Silver, or coho. | Chum. | Steelhead. |
| 1899. | 1,215,000 | | | | 881,000 | | | 190,000 |
| 1900. | 2,355,300 | | | | 634,400 | | | |
| 1901. | 1,909,800 | | | | 2,193,019 | 1,800,000 | | 500,000 |
| 1902. | | | | | 819,504 | 204,875 | | 420,390 |
| 1903. | | | | | 630,000 | 1,800,000 | | 288,000 |
| 1904. | 900,000 | | | | 523,650 | 2,160,000 | | 171,550 |
| 1905. | | 2,563,380 | 1,468,800 | | 393,660 | 2,250,000 | | 525,500 |
| 1906. | | 2,250,000 | 900,000 | | 678,000 | 654,500 | | 148,500 |
| 1907. | 163,000 | 3,275,000 | 2,064,000 | | 322,200 | 501,000 | | 399,000 |
| 1908. | 148,000 | 1,800,000 | 1,757,000 | | 455,200 | 64,000 | | |
| 1909. | 403,000 | 1,577,000 | 859,000 | | 734,350 | 2,457,900 | | 300,000 |
| 1910. | 111,150 | 4,041,900 | 900,960 | 967,500 | 748,690 | 3,111,750 | | 393,825 |
| 1911. | 118,750 | 3,575,700 | 1,082,790 | 93,752 | 729,600 | 1,386,000 | | 382,500 |
| 1912. | 119,700 | 1,090,200 | 3,177,000 | 112,500 | 3,247,345 | 1,785,580 | | 218,555 |
| 1913. | 139,000 | 2,977,260 | 4,667,300 | 701,118 | 302,461 | 581,730 | 1,581,750 | 105,440 |
| 1914. | 73,337 | 4,790,474 | 1,230,000 | 551,302 | 2,570,165 | 108,550 | 1,181,720 | |
| 1915. | 854,170 | 6,811,315 | 4,218,930 | 638,733 | 2,178,185 | 505,000 | | |
| 1916. | 495,350 | 120,000 | 2,500,000 | | 5,411,725 | 1,800,901 | 2,359,805 | 771,000 |
| 1917. | 2,978,288 | 12,275,990 | 17,725,949 | 967,975 | 1,460,206 | 372,500 | 318,100 | 197,000 |
| 1918. | | | | | | | | |
| 1919. | 279,200 | 6,017,655 | 4,793,000 | 1,847,400 | | | | |
| Total. | 12,293,045 | 53,765,874 | 43,205,379 | 6,150,280 | 24,908,810 | 21,646,287 | 5,441,376 | 4,932,920 |

^a Includes 14,400 eggs.^b Includes 100,000 eggs.^c Includes 25,000 eggs.^d All fingerlings.

PLANTS OF SALMON IN THE WATERS OF WASHINGTON OTHER THAN THE COLUMBIA RIVER—Continued.

| Year ending June 30— | Total by species. | | | | | | Grand total. |
|----------------------|-------------------|-------------|------------------|------------|-------------|------------|---------------|
| | Chinook. | Sockeye. | Silver, or coho. | Hump-back. | Chum. | Steelhead. | |
| 1878..... | a 3,000 | | | | | | 3,000 |
| 1897..... | | 5,500,000 | | | | | 5,500,000 |
| 1898..... | | 5,400,000 | | | | | 5,400,000 |
| 1899..... | 8,685,000 | | 189,000 | | | | 8,874,000 |
| 1900..... | 3,236,300 | 10,683,000 | 6,749,280 | | 10,301,760 | 1,762,560 | 32,732,900 |
| 1901..... | 2,863,200 | 3,834,453 | 14,360,185 | | 16,478,280 | 1,398,476 | 38,934,594 |
| 1902..... | 2,141,322 | 3,371,000 | 23,161,069 | | 9,937,390 | 2,591,371 | 41,202,152 |
| 1903..... | 4,276,869 | 3,731,789 | 23,307,771 | | 9,937,390 | 3,826,091 | 45,079,910 |
| 1904..... | 3,585,437 | 3,855,000 | 14,276,721 | 471,797 | | 3,938,866 | 26,127,821 |
| 1905..... | 3,229,738 | | 18,241,375 | | | 1,617,940 | 23,080,053 |
| 1906..... | 5,348,940 | 3,582,630 | 34,493,794 | 969,990 | 3,268,800 | 3,348,724 | 51,012,878 |
| 1907..... | 4,301,258 | | 31,460,552 | 4,224,255 | 6,120,000 | 4,490,808 | 50,596,873 |
| 1908..... | 9,198,309 | 8,514,305 | 41,542,966 | 9,420,662 | 4,342,350 | 4,714,991 | 77,733,583 |
| 1909..... | 10,117,488 | 5,430,626 | 30,926,310 | | 7,805,000 | 4,898,141 | 59,177,565 |
| 1910..... | 12,539,260 | 4,554,825 | 38,478,125 | 1,887,600 | 8,607,500 | 6,292,338 | 72,359,648 |
| 1911..... | 5,829,982 | 5,495,000 | 36,441,665 | 96,000 | 12,975,020 | 6,078,830 | 66,917,497 |
| 1912..... | 5,513,604 | 4,692,573 | 46,476,064 | 5,432,110 | 4,578,930 | 7,131,382 | 73,824,663 |
| 1913..... | 8,410,628 | 5,751,700 | 59,204,407 | 1,888 | 34,586,640 | 10,526,400 | 118,481,663 |
| 1914..... | 10,779,171 | 2,803,261 | 46,976,751 | 22,651,415 | 16,032,346 | 5,393,944 | 104,636,888 |
| 1915..... | 15,618,445 | 10,929,647 | 80,076,317 | 7,508,004 | 54,663,800 | 5,592,895 | 174,389,108 |
| 1916..... | 26,283,919 | 18,403,728 | 51,173,801 | 14,923,627 | 47,942,599 | 6,632,299 | 165,359,973 |
| 1917..... | 30,474,530 | 14,816,233 | 13,413,235 | 7,614,030 | 22,312,330 | 3,399,510 | 92,029,868 |
| 1918..... | 44,339,439 | 22,902,035 | 53,684,416 | 12,955,086 | 72,760,506 | 10,111,087 | 216,752,569 |
| 1919..... | 24,388,808 | 15,005,520 | 22,559,757 | 2,723,958 | 30,625,185 | 5,196,912 | 100,500,140 |
| Total..... | 241,155,647 | 159,258,325 | 687,193,561 | 90,880,422 | 373,275,826 | 98,943,565 | 1,650,707,346 |

a These were brought from the Clackamas (Oreg.) station and planted in some unnamed lake.

BRITISH COLUMBIA.

Fraser River.—The first hatchery established by the Dominion of Canada on the Pacific coast was erected in 1884 at what is now Bon Accord, a point on the lower river some 4 miles above New Westminster, and on the opposite shore. The next built was in 1901 on Granite Creek, Shuswap Lake, which discharges into the Fraser through the South Thompson River, the lake being about 280 miles from New Westminster. In 1904 another hatchery was established on Harrison Lake on the Lillooet River, first large tributary of the Fraser on the north side; also one about 4 miles east of the lower extremities of Pemberton Meadows, at the junction of Owl Creek and the Birkenhead River, 4 miles above its confluence with the eastern branch of the Lillooet River, which in turn discharges into Lillooet Lake. In 1907 a hatchery was built on Stuart Lake, near the headwaters of the Fraser.

In 1914 the Bon Accord hatchery had to be abandoned, due to the laying out of a town site around it, and the equipment was transferred to Queen's Park, New Westminster.

The Province of British Columbia owns Seton Lake hatchery, which was established in 1903 on Lake Creek, on the north side, about half a mile from the outlet of Seton Lake, and it has been operated continuously ever since. Seton Lake is a part of the Fraser River chain and is some 300 miles above the mouth of the river. Lake Creek, the outlet of Seton Lake, empties into the Cayoosh Creek, a tributary of the Fraser, 45 miles north of the latter's junction with the Thompson, and 1 mile south of the town of Lillooet.

In 1916 a subsidiary station was built by the Dominion on Cultus Lake to accommodate the surplus eggs which could not be handled in the Harrison and Pemberton hatcheries.

In 1913, the year of the quadriennially big run of sockeye salmon on the Fraser River, the contractors who were building the new Canadian Northern Railway, in blasting their way along the banks of the river, threw the rock and other débris into the stream until in the narrow part of the canyon south of North Bend at Whites Creek, Hells Gate, China Bar, and Scuzzy Rapids, all within a few miles of each other, the débris formed great sloping banks extending out into the stream at these points, and entirely changed the direction of the currents, and, of course, the velocity of the water. At best the salmon had a hard time getting through there, but the added obstructions rendered it practically impossible.

At a rather late hour the authorities woke up to the menace this work was to the run of salmon, and the dumping of débris into the river in such a manner as to obstruct their ascent was stopped.

How to clear the stream once more was now the problem, and this was seriously complicated by a slide of rock which took place in Hells Gate in February, 1914, which narrowed the channel of the stream considerably.

In March, 1914, the Dominion Marine and Fisheries Department contracted with a private concern to remove the obstructions, and this was done from Scuzzy Rapids, China Bar, and Whites Creek within a short period of time, but a couple of seasons' work were required to clear up Hells Gate so as to permit of passage for the fish. Some people claim that the fish still find it difficult to pass these obstructions.

Rivers Inlet.—A hatchery was established by the Dominion on McTavish Creek, one of the tributaries of Oweekayno Lake, about 20 miles up Rivers Inlet, in 1905, and has been operated ever since.

Skeena River.—In 1902 the Dominion established a hatchery on Lakelse Lake, in the Skeena River Basin, about 65 miles up the river from Port Essington. In 1919 a modern hatchery was commenced to replace the old one that was put out of commission by floods in 1917. In 1907 another was constructed on Babine Lake, the source of the Skeena River.

Vancouver Island.—In 1902 S. A. Spencer, of the Alert Bay cannery (now belonging to the British Columbia Packers' Association), in return for certain special fishery privileges granted by the Dominion, established a hatchery on the Nimpkish River, which is located on the northeast shore of Vancouver Island. The hatchery was burned down in 1903, but was immediately rebuilt. Since its establishment it has been operated by the Dominion.

In 1910 the Dominion put three new hatcheries into operation, all on Vancouver Island. They were located on Anderson Lake, Kennedy Lake, and Cowichan Lake, respectively. The two former are used for sockeyes and the latter for king and coho salmon and steelhead and other varieties of trout.

In 1915-16 the Draney Fisheries (Ltd.), operated a hatchery on a lake near by and hatched out 560,000 fry from eggs obtained from Rivers Inlet.

The following table shows the plantings made in the waters of British Columbia from the Dominion and provincial hatcheries:

PLANTS OF SALMON FRY MADE IN THE WATERS OF BRITISH COLUMBIA.

| Year. | Fraser River. ^a | | | | | | |
|-------------------|----------------------------|------------------|------------------|-------------|-------------|------------------|---------------|
| | Chum. | Coho, or silver. | Spring, or king. | Hump-back. | Sockeye. | Steelhead trout. | Total. |
| 1885 | | | | | 1,800,000 | | 1,800,000 |
| 1886 | | | | | 2,625,000 | | 2,625,000 |
| 1887 | | | | | 4,414,000 | | 4,414,000 |
| 1888 | | | | | 5,807,000 | | 5,807,000 |
| 1889 | | | | | 4,419,000 | | 4,419,000 |
| 1890 | | | | | 6,640,000 | | 6,640,000 |
| 1891 | | | | | 3,603,800 | | 3,603,800 |
| 1892 | | | | | 6,000,000 | | 6,000,000 |
| 1893 | | | | | 5,674,000 | | 5,674,000 |
| 1894 | | | | | 6,300,000 | | 6,300,000 |
| 1895 | | | | | 6,390,000 | | 6,390,000 |
| 1896 | | | | | 10,393,000 | | 10,393,000 |
| 1897 | | | | | 5,928,000 | | 5,928,000 |
| 1898 | | | | | 5,850,000 | | 5,850,000 |
| 1899 | | | | | 4,742,000 | | 4,742,000 |
| 1900 | | | | | 6,200,000 | | 6,200,000 |
| 1902 ^b | | 90,000 | | | 15,808,000 | 75,000 | 15,973,000 |
| 1903 | 75,000 | 1,750,000 | 22,000 | | 12,521,000 | | 14,368,000 |
| 1904 | | 210,000 | | 50,000 | 13,729,200 | 12,000 | 14,001,200 |
| 1905 | | 5,576,100 | 4,381,400 | | 9,244,300 | | 19,201,800 |
| 1906 | | 4,774,000 | 1,791,500 | | 100,479,000 | 4,000 | 107,048,500 |
| 1907 | | 3,219,200 | 1,814,900 | | 36,965,900 | | 42,000,000 |
| 1908 | | 5,890,000 | 2,815,000 | 22,500,000 | 51,855,200 | | 83,060,200 |
| 1909 | | 7,375,400 | 5,772,400 | | 41,909,500 | | 55,057,300 |
| 1910 | | 450,000 | 6,300,000 | | 105,312,500 | | 112,062,500 |
| 1911 | | 5,318,800 | 2,129,500 | | 24,146,300 | | 31,594,600 |
| 1912 | | 3,899,500 | 5,962,500 | 28,773,350 | 34,183,850 | | 72,819,200 |
| 1913 | 1,100,000 | 1,995,000 | 4,533,550 | | 41,062,700 | | 48,691,850 |
| 1914 | | 1,522,000 | 50,000 | 500,000 | 92,308,000 | | 94,380,000 |
| 1915 | 125,000 | 2,196,000 | 2,614,700 | | 27,496,000 | | 32,431,700 |
| 1916 | | 1,652,000 | 2,540,000 | c 3,834,000 | 487,201,000 | | 75,227,000 |
| 1917 ^e | 5,250,000 | 1,971,900 | 1,645,200 | 4,788,000 | 27,903,600 | | 41,564,700 |
| 1918 ^e | 378,000 | 1,729,800 | 2,763,000 | 13,940,100 | 37,153,350 | | 55,964,250 |
| 1919 | 383,000 | 1,800,625 | 2,291,200 | 40,000 | 142,071,825 | 30,000 | 46,616,650 |
| Total..... | 7,317,000 | 51,420,925 | 47,426,850 | 74,425,450 | 868,137,025 | 121,000 | 1,048,848,250 |

| Year. | Skeena River. | | | Rivers Inlet. | | | Nimkish River. |
|------------|---------------|-------------|-------------|------------------|-------------|-------------|----------------|
| | Hump-back. | Sockeye. | Total. | Spring, or king. | Sockeye. | Total. | Sockeye. |
| 1903 | | 3,450,000 | 3,450,000 | | | | 1,636,000 |
| 1904 | | 4,000,000 | 4,000,000 | | | | 2,496,000 |
| 1905 | | 3,767,900 | 3,767,900 | | | | 2,850,000 |
| 1906 | | 3,784,450 | 3,784,450 | | 8,000,000 | 8,000,000 | 4,873,400 |
| 1907 | | 4,125,750 | 4,125,750 | | 8,440,000 | 8,440,000 | 4,870,000 |
| 1908 | | 8,946,950 | 8,946,950 | 4,706,000 | 8,594,000 | 13,300,000 | 4,800,000 |
| 1909 | | 11,882,400 | 11,882,400 | | 13,300,000 | 13,300,000 | 5,000,000 |
| 1910 | | 11,521,700 | 11,521,700 | | 12,750,000 | 12,750,000 | 5,055,000 |
| 1911 | | 12,556,470 | 12,556,470 | | 11,436,000 | 11,436,000 | 6,414,000 |
| 1912 | | 12,367,500 | 12,367,500 | | 11,791,000 | 11,791,000 | 5,114,500 |
| 1913 | | 11,430,430 | 11,430,430 | | 10,981,000 | 10,981,000 | 4,981,000 |
| 1914 | | 11,843,200 | 11,843,200 | | 12,397,000 | 12,397,000 | 5,053,000 |
| 1915 | 16,000 | 11,899,613 | 11,915,613 | | 12,712,000 | 12,712,000 | 4,880,000 |
| 1916 | | 11,202,257 | 11,202,257 | | 12,594,100 | 12,594,100 | 4,980,000 |
| 1917 | | 12,105,000 | 12,105,000 | | 13,305,000 | 13,305,000 | ..... |
| 1918 | | 8,190,000 | 8,190,000 | | 2,721,600 | 2,721,600 | ..... |
| 1919 | | 8,096,000 | 8,096,000 | | 2,908,800 | 2,908,800 | 4,874,000 |
| Total..... | 16,000 | 151,109,620 | 151,185,620 | 4,706,000 | 141,931,100 | 146,637,100 | 67,376,900 |

^a Some of the reports from the provincial hatchery at Seton Lake show merely the take of eggs; it has been necessary to make an arbitrary reduction in order to show the loss of eggs and fry before planting.

^b No plants made in 1901.

^c 3,549,000 were eggs.

^d 3,242,000 were eggs.

^e All were given as eggs, and an arbitrary reduction was made in order to show the loss in eggs and fry before planting.

^f 500,000 were eggs; of the eggs from which the total plantings were made, 8,096,000 were obtained from the Skeena River.

^g Includes 80,000 coho fry.

PLANTS OF SALMON FRY MADE IN THE WATERS OF BRITISH COLUMBIA—Continued.

| Year. | Vancouver Island. | | | | | |
|------------|-------------------|------------------|------------------|-------------|------------------|-------------|
| | Chum. | Coho, or silver. | Spring, or king. | Sockeye. | Steelhead trout. | Total. |
| 1911..... | 40,000 | 4,550,000 | 425,000 | 7,862,000 | 145,200 | 13,022,200 |
| 1912..... | | 3,487,500 | 456,000 | 13,620,750 | 37,200 | 17,601,450 |
| 1913..... | | 3,180,000 | 712,500 | 15,031,750 | 173,900 | 19,098,150 |
| 1914..... | | 2,252,000 | 701,000 | 15,314,500 | 87,200 | 18,354,700 |
| 1915..... | | 2,229,220 | 250,000 | 15,911,000 | 55,000 | 18,445,820 |
| 1916..... | | 1,689,826 | 576,400 | 7,966,000 | 38,600 | 10,270,826 |
| 1917..... | | 1,426,860 | 1,209,600 | 2,862,000 | ..... | 5,498,460 |
| 1918..... | | 2,200,410 | 418,950 | 4,527,338 | ..... | 7,146,698 |
| 1919..... | | 2,152,194 | a 431,760 | b 4,589,250 | c 33,798 | 7,207,002 |
| Total..... | 40,000 | 23,168,010 | 5,181,810 | 87,684,588 | 570,898 | 116,645,306 |

| Year. | Total by species. | | | | | | Grand total. |
|------------|-------------------|------------------|------------------|------------|---------------|------------------|---------------|
| | Chum. | Coho, or silver. | Spring, or king. | Hump-back. | Sockeye. | Steelhead trout. | |
| 1885..... | | | | | 1,800,000 | ..... | 1,800,000 |
| 1886..... | | | | | 2,625,000 | ..... | 2,625,000 |
| 1887..... | | | | | 4,414,000 | ..... | 4,414,000 |
| 1888..... | | | | | 5,807,000 | ..... | 5,807,000 |
| 1889..... | | | | | 4,419,000 | ..... | 4,419,000 |
| 1890..... | | | | | 6,640,000 | ..... | 6,640,000 |
| 1891..... | | | | | 3,603,800 | ..... | 3,603,800 |
| 1892..... | | | | | 6,000,000 | ..... | 6,000,000 |
| 1893..... | | | | | 5,674,000 | ..... | 5,674,000 |
| 1894..... | | | | | 6,300,000 | ..... | 6,300,000 |
| 1895..... | | | | | 6,390,000 | ..... | 6,390,000 |
| 1896..... | | | | | 10,393,000 | ..... | 10,393,000 |
| 1897..... | | | | | 5,928,000 | ..... | 5,928,000 |
| 1898..... | | | | | 5,850,000 | ..... | 5,850,000 |
| 1899..... | | | | | 4,742,000 | ..... | 4,742,000 |
| 1900..... | | | | | 6,200,000 | ..... | 6,200,000 |
| 1902..... | | 60,000 | ..... | ..... | 15,808,000 | 75,000 | 15,973,000 |
| 1903..... | 75,000 | 1,750,000 | 22,000 | ..... | 17,607,000 | ..... | 19,454,000 |
| 1904..... | | 210,000 | ..... | 50,000 | 20,225,200 | 12,000 | 20,497,200 |
| 1905..... | | 5,576,100 | 4,381,400 | ..... | 15,862,200 | ..... | 25,819,700 |
| 1906..... | | 4,774,000 | 1,791,500 | ..... | 117,136,870 | 4,000 | 123,706,350 |
| 1907..... | | 3,219,200 | 1,814,900 | ..... | 54,401,650 | ..... | 59,435,750 |
| 1908..... | | 5,860,000 | 7,521,000 | 22,500,000 | 74,126,150 | ..... | 110,107,150 |
| 1909..... | | 7,375,400 | 5,772,400 | ..... | 71,591,900 | ..... | 84,739,700 |
| 1910..... | | 450,000 | 6,300,000 | ..... | 134,639,200 | ..... | 141,389,200 |
| 1911..... | 40,000 | 9,868,800 | 2,554,500 | ..... | 62,414,770 | 145,200 | 75,023,270 |
| 1912..... | | 7,387,000 | 6,418,500 | 28,773,350 | 77,077,600 | 37,200 | 119,693,650 |
| 1913..... | 1,100,000 | 5,175,000 | 5,246,050 | ..... | 83,486,880 | 173,000 | 95,182,430 |
| 1914..... | | 3,774,000 | 751,000 | 500,000 | 136,915,700 | 87,200 | 142,027,900 |
| 1915..... | 125,000 | 4,425,220 | 2,865,300 | 16,000 | 72,898,613 | 55,000 | 80,385,133 |
| 1916..... | | 3,341,826 | 3,116,460 | 3,524,000 | 165,943,857 | 38,000 | 114,271,183 |
| 1917..... | 5,256,000 | 3,398,760 | 2,854,860 | 4,788,000 | 56,176,200 | ..... | 72,473,760 |
| 1918..... | 378,000 | 3,930,210 | 3,181,950 | 13,940,100 | 52,592,288 | ..... | 74,022,548 |
| 1919..... | 383,000 | 3,952,819 | 2,722,960 | 40,000 | 65,539,875 | 63,798 | 69,702,452 |
| Total..... | 7,357,000 | 74,588,935 | 57,314,660 | 74,441,450 | 1,316,299,233 | 691,898 | 1,468,190,276 |

a Includes 24,261 fingerlings.

b Includes 265,700 advanced fry and 26,000 fingerlings.

c Includes 5,357 fingerlings.

ALASKA.

In 1891 several of the canneries operating at Karluk, on Kodiak Island, combined forces and built a hatchery on the lagoon at that place. As the cannery men were at sword's points in regard to their fishing rights on the spit, in 1892 the hatchery was closed. In May, 1896, the Alaska Packers Association broke ground for a hatchery at the eastern end of the lagoon, near the outlet of Karluk River, a short distance from where the hatchery was located in 1891, and operated it until 1916, when it was abandoned as a hatchery.

In 1892 Capt. John C. Callbreath, manager of the Point Ellis cannery on Kuiu Island, operated a small hatchery on the left bank of Kutlakoo stream. It was a very primitive place, and an exceptionally high tide destroyed the whole plant in September. It was never rebuilt.

Capt. Callbreath, however, after seeing to the operation of the hatchery, had returned to Wrangell during the summer, where his attention was again attracted to hatchery work, and in the fall of 1892 he built a small hatchery on Jadeska stream, Etolin Island, about 200 yards from its mouth. The stream is about one-half mile in length and is the outlet of a small lake. Finding the location unsuitable, Capt. Callbreath removed the hatchery in 1893 to the northern side of the lake, about three-eighths of a mile from the head of the outlet, where it still stands. The owner's intention was to build up a stream which had a small natural run of red salmon until it had a large run, with the hope that the Government would then give him the exclusive right to take these fish from the stream for commercial purposes. The experiment was kept up until the end of the season of 1905, when Capt. Callbreath's failing eyesight compelled the cessation of the actual hatching. Until 1910 a man was stationed on the stream during the run of spawning fish for the purpose of lifting them over the dam, so that they could reach the spawning beds at the head of the lake, and the project was abandoned entirely shortly thereafter. The owner's expectation of a big run as a result of hatching operations was never realized.

In 1896 the Baranof Packing Co., which operated a cannery on Redfish Bay, on the western coast of Baranof Island, built a small hatchery on the lake at the head of Redfish stream. The following winter was so cold that not only the flume but the whole cataract froze solid, and as the hatchery was thus left without water the eggs were put into the lake and left to their fate and the hatchery closed down permanently.

In 1897 the North Pacific Trading & Packing Co., at Klawak, Prince of Wales Island, established a hatchery near the head of Klawak stream, close to Klawak Lake. In 1898 the plant was moved to the mouth of a small stream entering the lake about halfway up the western shore. This hatchery was operated continuously until the end of 1917, since when it has been shut down. In 1909 the North Alaska Salmon Co. acquired a half interest in it, which it relinquished to the original owners a few years later.

The Pacific Steam Whaling Co. in 1898 erected a small hatchery on Hetta Lake, on the west side of Prince of Wales Island, which was operated until the close of the hatching season of 1903-4, when the Pacific Packing & Navigation Co., successor to the original owner, went into the hands of a receiver. In 1907 it was reopened by the Northwestern Fisheries Co., which had acquired the interests of the old company, and has been operated each season since, with the exception of 1919.

Up to 1900 the work of hatching salmon was entirely voluntary on the part of the packers. On May 2 of that year the following regulation was promulgated at the Treasury Department, which at that time had control of the Alaska salmon-inspection service:

7. Each person, company, or corporation taking salmon in Alaskan waters shall establish and conduct, at or near the fisheries operated by him or them, a suitable

artificial propagating plant or hatchery, and shall produce yearly and place in the natural spawning waters of each fishery so operated red-salmon fry in such numbers as shall be equal to at least four times the number of mature fish taken from the said fisheries by or for him or them during the preceding fishing season. The management and operation of such hatcheries shall be subject to such rules and regulations as may hereafter be prescribed by the Secretary of the Treasury. They shall be open for inspection by the authorized official of this department; annual reports shall be made, giving full particulars of the number of male and female salmon stripped, the number of eggs treated, the number and percentage of fish hatched, and all other conditions of interest; and there shall be made a sworn yearly statement of the number of fry planted and the exact location where said planting was done.

On January 24, 1902, this regulation was amended so as to require the planting of "red-salmon fry in such numbers as shall be equal to at least ten times the number of salmon of all varieties taken from the said fisheries."

Although the regulation was mandatory, but few of the packers obeyed it, some because no suitable place was to be found within a reasonable distance of their plants, others because the establishment and operation of such a hatchery would cost more than their returns from the industry justified, and others because of lack of knowledge required in hatchery work. The greater number of them absolutely ignored it, and as a result those who conformed to the regulation were placed under a heavy financial handicap. The injustice of this arrangement was patent on its face, and in 1906, when a comprehensive revision of the law was made by Congress, provision was made for reimbursing in the future those cannery men who operated salmon hatcheries. The section covering this point reads as follows:

SEC. 2. That the catch and pack of salmon made in Alaska by the owners of private salmon hatcheries operated in Alaska shall be exempt from all license fees and taxation of every nature at the rate of ten cases of canned salmon to every one thousand red or king salmon fry liberated, upon the following conditions:

That the Secretary of Commerce and Labor may from time to time, and on the application of the hatchery owner shall, within a reasonable time thereafter, cause such private hatcheries to be inspected for the purpose of determining the character of their operations, efficiency, and productiveness, and if he approve the same shall cause notice of such approval to be filed in the office of the clerk or deputy clerk of the United States district court of the division of the District of Alaska wherein any such hatchery is located, and shall also notify the owners of such hatchery of the action taken by him. The owner, agent, officer, or superintendent of any hatchery the effectiveness and productiveness of which has been approved as above provided shall, between the thirtieth day of June and the thirty-first day of December of each year, make proof of the number of salmon fry liberated during the twelve months immediately preceding the thirtieth day of June by a written statement under oath. Such proof shall be filed in the office of the clerk or deputy clerk of the United States district court of the division of the District of Alaska wherein such hatchery is located, and when so filed shall entitle the respective hatchery owners to the exemption as herein provided; and a false oath as to the number of salmon fry liberated shall be deemed perjury and subject the offender to all the pains and penalties thereof. Duplicates of such statements shall also be filed with the Secretary of Commerce and Labor.

It shall be the duty of such clerk or deputy clerk in whose office the approval and proof heretofore provided for are filed to forthwith issue to the hatchery owner, causing such proofs to be filed, certificates which shall not be transferable and of such denominations as said owner may request (no certificate to cover fewer than one thousand fry), covering in the aggregate the number of fry so proved to have been liberated; and such certificates may be used at any time by the person, company, corporation, or association to whom issued for the payment pro tanto of any license fees or taxes upon or against or on account of any catch or pack of salmon made by them in Alaska; and it shall be the duty of all public officials charged with the duty of collecting or receiving such license fees or taxes to accept such certificates in lieu of money in payment of all license fees or taxes upon or against the pack of canned salmon at the ratio of one thousand fry for each ten cases of salmon. No hatchery owner shall obtain the rebates from the output of any hatchery to which he might

otherwise be entitled under this act unless the efficiency of said hatchery has first been approved by the Secretary of Commerce and Labor in the manner herein provided for.

Of recent years so much objection has been raised to the system of hatchery rebates that the matter of the Federal Government taking over all private hatcheries in Alaska, at a fair valuation, and operating same, is being favorably considered.

In 1901 the Pacific Steam Whaling Co. established two small hatcheries—one on Nagel Stream, which enters the northern side of Quadra Lake, on the mainland of southeast Alaska, and one on a stream entering Freshwater Lake Bay, Chatham Strait. Both were closed down in 1904 when the company failed. In 1908 the Northwestern Fisheries Co., which had acquired the Quadra plant, removed it to a small stream entering the head of the lake and has operated it ever since.

In 1901 the Alaska Packers Association erected a hatchery on Heckman Lake, the third of a series of lakes on Naha Stream, Revillagigedo Island, and about 8 miles from Loring, where the association has a cannery. This, known as Fortmann hatchery, is without question the largest and costliest salmon hatchery in the world, having a capacity of 110,000,000 eggs, and the association is entitled to great credit for the public spirit it has shown and the work it has done, entirely without remuneration until 1906, in building and operating not only this hatchery but also the one at Karluk.

The Union Packing Co., at Kell Bay, on Kuiu Island, and F. C. Barnes, at Lake Bay, on Prince of Wales Island, in 1902 built and operated small hatcheries, both of which were abandoned after one season's work.

Up to 1905 the work of hatching salmon in Alaska was confined to the salmon cannery men. In that year, however, the United States Bureau of Fisheries erected a hatchery on Yes Lake, which empties through a short stream into Yes Bay, on Cleveland Peninsula. In 1907 the Bureau constructed another hatchery, on Afognak Lake, near Litnik Bay, Afognak Island.

The eruption of Katmai volcano, on the Alaska Peninsula, June 6, 1912, covered the island of Afognak with volcanic ash and sand to an average depth of 9 inches. It is estimated that 20,000 salmon perished at the head of Litnik Lake, while thousands were driven back into the ocean. As a result of these conditions the work at the Afognak station was much hampered and curtailed. Even as late as 1915 work at this station was still being hampered by the volcanic ash and sand which fell in 1912.

In 1913 collecting stations were established at Eagle Harbor and Uganak Lake, on Kodiak Island. In 1915 another was established at Seal Bay, on Afognak Island.

In 1913 a collecting station was established on Ketchikan Creek, but, owing to the objections of the citizens of the town against the taking away of the eggs, the station was abandoned in 1915.

The following tables show the eggs and fry distributed by the Government and privately owned hatcheries in Alaska:

OUTPUT OF THE SALMON HATCHERIES IN ALASKA OWNED BY THE U. S. BUREAU OF FISHERIES, 1906 TO 1919.

| Year ending June 30— | McDonald Lake or Yes Bay hatchery. | | | | | | | |
|-------------------------|------------------------------------|-------------|----------------------------|------------------------|-----------|-----------|------------|-------------|
| | Red, or sockeye. | | Coho, or silver fry. | Steel- head fry. | Humpback. | | Total. | |
| | Eggs. | Fry. | | | Eggs. | Fry. | Eggs. | Fry. |
| 1906..... | | 6,638,550 | | | | | | 6,638,550 |
| 1907..... | | 54,610,800 | | 143,500 | | | | 54,754,300 |
| 1908..... | | 61,369,000 | | | | | | 61,369,000 |
| 1909..... | | 48,653,000 | 9,900 | | | | | 48,662,900 |
| 1910..... | | 69,879,600 | | | | | | 69,879,600 |
| 1911..... | | 68,239,900 | | | 100,000 | | 100,000 | 68,239,900 |
| 1912..... | | 68,335,000 | | | | | | 68,335,000 |
| 1913..... | | 60,422,100 | | | | | | 60,422,100 |
| 1914..... | 2,000,000 | 42,726,400 | | | | 4,500,000 | 2,000,000 | 47,226,400 |
| 1915..... | | 37,445,000 | | | 2,000,000 | | 2,000,000 | 37,445,000 |
| 1916..... | 18,100,000 | 52,317,500 | | | | | 18,100,000 | 52,317,500 |
| 1917..... | 2,000,000 | 51,175,000 | | | | | 2,000,000 | 51,175,000 |
| 1918..... | | 32,539,200 | | | | | | 32,539,200 |
| 1919..... | 447,300,000 | 32,650,000 | | | 1,365,000 | 930,000 | 48,665,000 | 33,580,000 |
| Total..... | 69,400,000 | 687,001,050 | 9,900 | 143,500 | 3,465,000 | 5,430,000 | 72,865,000 | 692,581,450 |

| Year ending June 30— | Afognak hatchery. | | | | | | |
|-------------------------|-------------------|-------------|----------------------------|------------|------------|-------------|-------------|
| | Red, or sockeye. | | Coho, or silver fry. | Humpback. | | Total. | |
| | Eggs. | Fry. | | Eggs. | Fry. | Eggs. | Fry. |
| 1909 | | 39,325,870 | | | 10,000 | | 39,335,870 |
| 1910 | | 71,647,170 | | | 363,740 | | 72,010,910 |
| 1911 | | 26,755,000 | | | 364,150 | | 27,119,150 |
| 1912 | | 18,394,700 | | 3,271,740 | | 3,271,740 | 18,394,700 |
| 1913 | | 12,551,100 | | | | | 12,551,100 |
| 1914 | 3,970,000 | 7,761,705 | 50,000 | | 12,034,399 | 3,970,000 | 19,846,104 |
| 1915 | | 76,387,080 | | 12,500,000 | 6343,480 | 12,500,000 | 6,730,560 |
| 1916 | | 22,933,640 | | | | | 22,933,640 |
| 1917 | | 21,116,000 | | | | | 21,116,000 |
| 1918 | 18,000,000 | 31,427,000 | | | | 18,000,000 | 31,427,000 |
| 1919 | 54,681,000 | 24,903,000 | | 8,697,000 | 2,142,000 | 63,378,000 | 27,045,000 |
| Total | 76,651,000 | 283,202,265 | 50,000 | 24,468,740 | 15,257,769 | 101,119,740 | 298,510,034 |

a Includes 2,925,000 fingerlings, yearlings, or adults.

b Includes 19,402,500 fingerlings.

c Includes 1,575,000 fingerlings.

d 1,059,900 sockeye eggs were shipped to the Little White Salmon hatchery, and 3,440,100 to the Oregon Fish Commission.

e Includes 6,000,000 fingerlings.

f Includes 5,444,830 fingerlings, yearlings, or adults.

g Includes 119,480 fingerlings, yearlings, or adults.

h Includes 11,100,440 fingerlings. Of the eggs from which these fry and fingerlings were hatched 15,000,000 came from Yes Bay hatchery.

i Includes 10,160,000 fingerlings.

j 5,100,000 of these eggs were shipped to the Bureau's Quinalt (Wash.) hatchery, and 20,700,000 to the Province of British Columbia.

k 5,700,000 of these eggs were shipped to the Bureau's Puget Sound hatcheries.

OUTPUT OF THE SALMON HATCHERIES IN ALASKA OWNED BY THE U. S. BUREAU OF FISHERIES, 1906 TO 1919—Continued.

| Year ending June 30— | Total, by species, both hatcheries. | | | | | Grand total. | |
|----------------------|-------------------------------------|-------------|----------------------|-----------------|------------|--------------|-------------------------|
| | Red, or sockeye. | | Coho, or silver fry. | Steel-head fry. | Humpback. | | |
| | Eggs. | Fry. | | | Eggs. | Fry. | Eggs. | Fry. |
| 1906..... | | 6,638,550 | | | | | 6,638,550 |
| 1907..... | | 54,610,800 | | 143,500 | | | 54,754,300 |
| 1908..... | | 61,369,000 | | | | | 61,369,000 |
| 1909..... | | 87,978,870 | 9,900 | | | 10,000 | 87,998,770 |
| 1910..... | | 141,526,770 | | | | 363,740 | 141,890,510 |
| 1911..... | | 94,994,900 | | | 100,000 | 364,150 | 95,359,050 |
| 1912..... | | 86,729,700 | | | 3,271,740 | | 86,729,700 |
| 1913..... | | 72,973,200 | | | | | 72,973,200 |
| 1914..... | 5,970,000 | 50,488,105 | 50,000 | | | 16,534,399 | 5,970,000 67,072,504 |
| 1915..... | | 443,832,080 | | | 14,500,000 | 4343,480 | 14,500,000 44,175,560 |
| 1916..... | 3,100,000 | 75,251,140 | | | | | 3,100,000 75,251,140 |
| 1917..... | 2,000,000 | 72,291,000 | | | | | 2,000,000 72,291,000 |
| 1918..... | 18,000,000 | 63,966,200 | | | | 18,000,000 | 63,966,200 |
| 1919..... | 101,981,000 | 57,553,000 | | | 10,062,000 | 3,072,000 | 112,043,000 60,625,000 |
| Total... | 131,051,000 | 970,203,315 | 59,900 | 143,500 | 27,933,740 | 20,687,769 | 158,984,740 991,094,484 |

a Includes 8,369,830 fingerlings, yearlings, or adults.

b Includes 119,480 fingerlings, yearlings, or adults.

c Includes 8,489,310 fingerlings, yearlings, or adults.

d 15,000,000 of the red salmon eggs shown under Yes Bay were transferred to Afognak, hatched out there and the fry counted under the "Fry" column of that hatchery.

TAKE OF EGGS, AND OUTPUT OF PRIVATE SALMON HATCHERIES OF ALASKA, 1893 TO 1919.

[Unless otherwise stated in footnotes, all of the fry liberated were red salmon.]

| Year ending June 30— | Callbreath's hatchery. | | Karluk hatchery. | | Klawak hatchery. | |
|----------------------|------------------------|------------|------------------|-------------|------------------|-------------|
| | Eggs. | Fry. | Eggs. | Fry. | Eggs. | Fry. |
| 1893..... | 900,000 | 600,000 | | | | |
| 1894..... | 3,000,000 | 2,204,000 | | | | |
| 1895..... | 6,300,000 | 5,291,000 | | | | |
| 1896..... | 6,200,000 | 5,475,000 | | | | |
| 1897..... | 4,400,000 | 4,390,000 | 3,236,000 | 2,556,440 | | |
| 1898..... | 3,400,000 | 2,526,000 | 8,454,000 | 6,340,000 | 2,023,000 | 800,000 |
| 1899..... | 3,000,000 | 2,050,000 | 4,491,000 | 3,369,000 | 3,600,000 | 3,000,000 |
| 1900..... | 3,400,000 | 2,335,000 | 10,496,900 | 7,872,000 | 3,600,000 | a 1,000,000 |
| 1901..... | (b) | | 19,334,000 | 15,566,800 | (c) | |
| 1902..... | 6,000,000 | 5,500,000 | 32,800,000 | 28,700,000 | 3,500,000 | 2,800,000 |
| 1903..... | 6,000,000 | 5,000,000 | 23,400,000 | 17,555,000 | 3,500,000 | 1,500,000 |
| 1904..... | 6,000,000 | 5,000,000 | 28,113,000 | 22,000,000 | 3,000,000 | 1,700,000 |
| 1905..... | 6,050,000 | 5,250,000 | 45,500,000 | 33,670,000 | 2,800,000 | 2,000,000 |
| 1906..... | 7,700,000 | 6,500,000 | 36,933,000 | 28,236,412 | 2,800,000 | 2,300,000 |
| 1907..... | (d) | | 38,679,200 | 36,846,000 | 3,600,000 | 1,187,000 |
| 1908..... | (e) | (e) | 47,808,200 | 43,655,000 | 3,500,000 | 2,776,000 |
| 1909..... | (e) | (e) | 40,320,000 | 37,105,000 | 3,500,000 | 3,200,000 |
| 1910..... | (e) | (e) | 45,228,000 | 40,620,000 | 5,800,000 | 5,300,000 |
| 1911..... | (e) | (e) | 49,626,000 | 37,722,000 | 6,786,500 | 6,200,000 |
| 1912..... | (f) | (f) | 41,026,800 | 37,495,100 | 5,600,000 | 3,530,000 |
| 1913..... | (f) | (f) | 45,600,000 | 41,803,155 | 3,835,000 | 3,675,000 |
| 1914..... | (f) | (f) | 34,629,160 | 31,546,080 | 3,645,000 | 3,465,000 |
| 1915..... | (f) | (f) | g 30,240,000 | 27,704,000 | 3,816,000 | 3,653,000 |
| 1916..... | (f) | (f) | 41,135,000 | 23,948,000 | 4,180,000 | 4,020,000 |
| 1917..... | (f) | (f) | h 1,016,000 | | 8,160,000 | 7,822,000 |
| 1918..... | (f) | (f) | (f) | (f) | (f) | (f) |
| 1919..... | (f) | (f) | (f) | (f) | (f) | (f) |
| Total..... | 62,350,000 | 52,121,000 | 628,066,260 | 524,309,987 | 77,245,500 | 59,928,000 |

a Many eggs frozen.

b No run of fish.

c Hatchery was not used, the eggs being hatched out in the lake.

d No report.

e Fish coming in to spawn were lifted over the dam.

f Not operated.

g A collection of 7,400,000 humpback eggs was made for Afognak, and these appear in the report of that hatchery.

h These eggs were turned over to the Afognak hatchery and the hatchery shut down.

i A considerable portion of these are coho eggs.

TAKE OF EGGS, AND OUTPUT OF PRIVATE SALMON HATCHERIES OF ALASKA, 1893 TO 1919—Continued.

| Year ending June 30— | Hetta hatchery. | | Quadra Bay hatchery. | | Freshwater Bay hatchery. | |
|----------------------|-----------------|------------|----------------------|-------------|--------------------------|-----------|
| | Eggs. | Fry. | Eggs. | Fry. | Eggs. | Fry. |
| 1899..... | 2,800,000 | 2,600,000 | | | | |
| 1900..... | 2,000,000 | 1,500,000 | | | | |
| 1901..... | 1,800,000 | 1,500,000 | | | | |
| 1902..... | 2,500,000 | 1,700,000 | 4,500,000 | 3,500,000 | 1,500,000 | 1,000,000 |
| 1903..... | 4,800,000 | 4,000,000 | 5,500,000 | 4,000,000 | (b) | (b) |
| 1904..... | 5,127,500 | 3,750,000 | 600,000 | c 400,000 | (d) | (d) |
| 1905..... | (e) | (e) | (e) | (e) | (e) | (e) |
| 1906..... | (e) | (e) | (e) | (e) | (e) | (e) |
| 1907..... | (e) | (e) | (e) | (e) | (e) | (e) |
| 1908..... | 8,000,000 | 6,125,000 | (e) | (e) | (e) | (e) |
| 1909..... | 8,400,000 | 8,134,000 | 3,325,000 | 3,025,750 | (e) | (e) |
| 1910..... | 10,313,000 | 9,000,000 | 10,863,000 | 9,850,000 | (e) | (e) |
| 1911..... | 9,141,000 | 8,552,500 | 11,200,000 | 10,350,000 | (e) | (e) |
| 1912..... | 2,555,000 | 2,342,000 | 11,000,000 | 10,166,000 | (e) | (e) |
| 1913..... | 3,780,000 | 3,592,000 | 10,000,000 | 8,127,000 | (e) | (e) |
| 1914..... | 4,082,000 | 3,590,500 | 18,400,000 | 17,054,000 | (e) | (e) |
| 1915..... | 7,438,500 | 7,142,500 | 21,300,000 | 20,300,000 | (e) | (e) |
| 1916..... | 7,408,000 | 7,092,000 | 8,114,000 | 7,598,000 | (e) | (e) |
| 1917..... | 3,247,000 | 3,120,000 | 16,125,000 | 15,003,000 | (e) | (e) |
| 1918..... | 4,826,000 | 4,587,000 | 13,600,000 | 12,990,000 | (e) | (e) |
| 1919..... | (e) | (e) | 20,400,000 | 19,852,000 | (e) | (e) |
| Total..... | 88,248,000 | 77,327,500 | 154,927,000 | 142,215,750 | 1,500,000 | 1,000,000 |

| Year ending June 30— | Fortmann hatchery. | | Kell Bay hatchery. | | Total. | |
|----------------------|--------------------|--------------|--------------------|-----------|---------------|---------------|
| | Eggs. | Fry. | Eggs. | Fry. | Eggs. | Fry. |
| 1893..... | | | | | 900,000 | 600,000 |
| 1894..... | | | | | 3,000,000 | 2,204,000 |
| 1895..... | | | | | 6,300,000 | 5,291,000 |
| 1896..... | | | | | 6,200,000 | 5,475,000 |
| 1897..... | | | | | 7,636,000 | 6,946,440 |
| 1898..... | | | | | 13,877,000 | 9,666,000 |
| 1899..... | | | | | 13,891,000 | 11,019,000 |
| 1900..... | | | | | 19,496,900 | 12,707,000 |
| 1901..... | | | | | 21,134,000 | 16,066,800 |
| 1902..... | 11,460,000 | 10,300,000 | | | 62,260,000 | 53,500,000 |
| 1903..... | 10,050,000 | 29,005,000 | 2,500,000 | 2,000,000 | 85,750,000 | 63,060,000 |
| 1904..... | 22,294,000 | 13,780,000 | (e) | (e) | 65,043,500 | 46,630,000 |
| 1905..... | 65,010,000 | 63,181,000 | (e) | (e) | 119,360,000 | 104,101,000 |
| 1906..... | 98,715,000 | 67,643,000 | (e) | (e) | 116,148,000 | 104,679,412 |
| 1907..... | 195,450,000 | 80,973,000 | (e) | (e) | 147,729,200 | 119,006,000 |
| 1908..... | f 11,280,000 | 33,920,000 | (e) | (e) | 100,588,200 | 86,476,000 |
| 1909..... | 24,495,000 | 22,785,000 | (e) | (e) | 80,010,000 | 74,249,750 |
| 1910..... | 53,340,000 | 50,725,000 | (e) | (e) | 125,544,000 | 115,495,000 |
| 1911..... | 34,823,000 | 30,245,000 | (e) | (e) | 111,673,500 | 93,069,500 |
| 1912..... | 107,520,000 | 100,335,000 | (e) | (e) | 167,731,800 | 153,868,100 |
| 1913..... | 23,160,000 | 20,800,000 | (e) | (e) | 86,375,000 | 77,997,155 |
| 1914..... | 9,480,000 | 8,700,000 | (e) | (e) | 70,236,160 | 64,355,880 |
| 1915..... | 22,500,000 | 20,820,000 | (e) | (e) | 85,294,500 | 79,619,500 |
| 1916..... | 26,520,000 | ø 25,615,000 | (e) | (e) | 87,357,000 | 68,273,000 |
| 1917..... | 62,580,000 | 57,405,000 | (e) | (e) | 94,128,000 | 83,350,000 |
| 1918..... | h 4,240,000 | i 7,980,000 | (e) | (e) | 22,666,000 | 25,557,000 |
| 1919..... | j 23,280,000 | 15,205,000 | (e) | (e) | 43,680,000 | 35,057,000 |
| Total..... | 746,173,000 | 659,417,000 | 2,500,000 | 2,000,000 | 1,761,009,760 | 1,518,319,237 |

a Many eggs frozen

b No run of fish.

c Hatchery was not used, the eggs being hatched in the lake.

d No report.

e Not operated.

f Includes 30,000 coho eggs taken and 27,000 fry liberated.

ø Includes 600,000 humpback eggs taken and 560,000 fry liberated.

h Includes 2,400,000 humpback eggs taken.

i Includes 1,845,000 humpback fry planted.

j Includes 3,660,000 humpback eggs.

THE SALMON FISHERIES OF SIBERIA.

As on the Alaska coast, the aborigines of Siberia must have learned early of the excellent food qualities of the salmon which each year frequented the rivers of that country for spawning purposes, and

not only ate them fresh but also dried large quantities for winter use for themselves and their dogs.

Owing to the inaccessibility of the Siberian coast, due mainly to the lack of transportation facilities for many years and the decided objection of the Russian Government to travelers roaming over the country, partly because of the presence of political and criminal convicts and partly because of a fear that they might learn too much of its resources, there has been but little written, especially with regard to its fishery resources, about this remote section of the Russian Empire, and what little has been published is usually filled with inaccuracies, due, doubtless, in many instances to the fact that the writer generally had to get most of his information at second and third hand and was also unfamiliar with fishery subjects.

Most of the data given below were obtained directly from persons living in Siberia or Japan, most of whom are engaged in the fishing industry of Siberia, or from Americans who have on various occasions visited the country in order to view its fishing possibilities at first hand.

SPECIES OF SALMON.

All five species of salmon are to be found along the Siberian coast, and the schools appear to run about the same as they do on the American side. Although we have very little authentic data relating to their movements, these are doubtless similar to the runs on the Alaska coast, where climatic and other conditions are very similar. Nearly all streams from the Arctic Ocean to north China seem to have runs of one or more species. The steelhead does not appear to be an inhabitant of the Asian coast.

The fishing carried on by the Russians has usually been along the rivers of the mainland, principally in the Amur and on Sakhalin Island.

From very early times Japanese fishermen have frequented the Siberian coast and Sakhalin Island (the southern portion of which they at one time owned, exchanging it to Russia for the Kurile Islands in 1875 and again acquiring it in 1905, as a result of the Russian-Japanese war), being drawn here mainly by the rich stores of salmon which could be secured easily and quickly, and were so necessary to eke out the vast quantity needed to supply such a fish-eating nation as Japan.

FISHING DISTRICTS.

The Priamur fishing district is subdivided into several districts as follows:

Nikolaevsk district.—This district comprises the whole lower part of the Amur River from the village Zimmermannovka down to the mouth of the river, about 300 miles; the River Amgun, 200 miles; the Amur estuary, about 150 miles on the mainland and about 130 miles on the coast of Sakhalin Island, and about 865 miles of the coast line on the southwestern shore of the Okhotsk Sea. In 1913 there were 139 fishing stations operated in this district, and this number has been materially increased since. Humpbacks and chums were the principal species of salmon taken.

Sakhalin district.—The Sakhalin district includes the entire coast line of Sakhalin island with the exception of that facing the Amur estuary, which belongs to the Nikolaevsk district. It is the smallest

district, and at present is of little importance. In 1913 there were 14 stations on the island and they produced chum and humpback salmon:

Okhotsk-Kamchatka district.—The Okhotsk section covers the coast line of the northern part of the Okhotsk Sea from Port Ayan to Penjin Promontory, about 1,620 miles. Chum, humpback, coho, and red salmon, and Dolly Varden trout are found here. The West Kamchatka section includes the coast line from the Sopotslnaya River down to the southern Ozernof shore fishing stations, a distance of about 335 miles. The Ozernaya River is, so far as known, the only river in this section that the red salmon visit in any quantities. In 1913 there were 152 fishing stations in this section, most of which were leased to Japanese. The number has since been increased. All five species of salmon and the Dolly Varden trout are found here. The East Kamchatka section covers the coast line of eastern Kamchatka and Anadir Peninsulas, about 1,843 miles. The majority of the fishing stations are concentrated around Karaginsky (Count Litka) Bay, in the straits from the Malo-Voyam River to Kitchigin River, about 135 miles long, and in the region of Kamchatka River. All five species of salmon and Dolly Varden trout are taken here and most of the canneries are located here and in the West Kamchatka section.

Southwestern district.—This district covers the waters from the southern boundary of the Amur River estuary (the line between Capes Lazarev and Pogibi) down to the Chosen frontier, including Vanina Bay, Imperial Harbor, Peter the Great Bay, and other bays. The total length of the shore line is about 1,350 miles. The northern part, from Lazarev-Pogibi line to Cape Povorotni, with the exception of various bays, includes the conventional waters, while the southern part, composed of Peter the Great Bay and Posiet Bay, are excluded from the conventional waters. In the first-named section chum and humpback salmon are caught to some extent. In the southern section chum and humpback salmon are taken and marketed fresh.

Amur River.—The Amur River is subdivided into two districts—the Marinsk, or the Lower Amur, district and the Khabarovsk district. The first named includes the area from the village Troitskoe to the village Sophiskoe, or a tract about 278 miles long. The Khabarovsk district includes the river line from the northern boundary of the Maryinsk district up the river to Khabarovsk, about 127 miles. Chum salmon form the bulk of the catch in this district.

FISHERY RIGHTS AND REGULATIONS.

Along the entire seacoast of Siberia, by virtue of the Russo-Japanese convention of 1907, concluded for 12 years, and, it is reported, with what truth we have no means of telling at present, renewed in 1919, the Japanese are permitted to engage in fishing on equal terms with Russians. In such sections there is no restriction with regard to the nationality of the laborers employed or the method of preparing the fish, except that the manufacture of fish manure from fish of the salmon variety is prohibited. On the face of it this convention looks like an equitable agreement, but in putting the Japanese on the same footing as the Russians it subjected them

to a lot of unstated and arbitrary laws, by-laws, and local regulations, besides making the tenure exceedingly short, virtually only one year, as a result of which Japanese capital refuses to erect more than the crudest of plants.

The Department of Domains fixes the limits of the stations, and these are sold at public tender, usually during February and March.

The exhaustion of the fishery resources of many of the European waters belonging to Russia has forced some of her more enterprising fishermen to seek for new supplies in her Siberian waters, and as these resources become better known, and means of transportation are increased and improved, there will doubtless be a tremendous impetus given to their development.

The World War which devastated Europe between 1914 and 1918 had a particularly disastrous effect on Russia, where the terribly devastating internecine warfare resulting from the revolution within her borders sapped her resources to such an extent that her Siberian fishery operators have been unable to do anything other than make a bare living out of the business and not even that in many cases owing to the uncertainty of business conditions. As a result of these distressing handicaps upon the operations of the Russians, the Japanese have had virtually a free hand in their exploitation of the coastal fishery resources of Siberia. As Siberia in the near future will be the greatest producer of salmon, it behooves us to bestir ourselves if we are to retain our command of the salmon market by taking an active part in the development of Siberia's fishery resources, for which development Russia has not heretofore welcomed foreign capital. When peace finally comes to that devastated land, however, her capital will be so depleted that she will doubtless welcome relief from whatever source it comes, and as she knows the United States has no territorial aspirations in her direction we will doubtless be far more welcome than the Japanese, of whose disinterestedness the Russians are extremely suspicious.

Fishing rights in the gulfs and bays not included in the Russo-Japanese convention, such as Peter the Great Bay, Imperial Harbor, Vanina Bay, Avatchinsk Bay, and others, as well as the rivers of Okhotsk and Kamchatka, are granted by the Governor General, without public tenders, to persons of good repute, but for one year only, and if they show their ability to establish a successful fishing station a lease for 12 years can be secured on the basis of paying a royalty of $2\frac{1}{2}$ cents per pood (36.112 pounds) of prepared fish. Under the terms of the lease only Russian subjects can be employed at the stations, while all sailing vessels serving the stations must be under the Russian flag.

The regulations governing the river districts vary from those relating to coast concessions, and also vary from each other, as the local authorities in the river districts are authorized to issue temporary rules and regulations to cover local conditions.

On the Amur River, within the boundaries of the Nikolaevsk, Maryinsk, and Khabarovsk districts, the fishing stations are leased by public auction to the highest bidder, some on a long-term basis and others for only one year. At stations above the city of Nikolaevsk, within 30 miles of the Amur estuary and farther, no foreign labor is allowed. Below the city of Nikolaevsk foreign labor can be

employed to handle the fish on shore, but the actual fishing can be done only by Russian subjects.

At the present time the chief aim of the Russian authorities is to break the monopoly the Japanese have of the fisheries along the greater part of the coast. This will be an exceedingly difficult thing to do, owing to the proximity of the Japanese to the Siberian coast, the ease with which they can transport by water the necessary supplies, etc., for carrying on the fisheries, the vastly greater skill in carrying on this work displayed by them over their Russian competitors, and their unlimited supply of cheap labor, while the Russian fisheries are badly hampered as a result of the few Russian subjects available for such work and the consequent high wage cost of same. Japan also has another big advantage in that she is at present almost the sole market for the greater part of the salmon and other fishes taken in Siberia. The very fact of this fish being necessary for feeding her people will cause Japan to battle hard to hold her present advantage.

In order to encourage opposition to the Japanese, the Russian authorities in 1913 gave to Denbigh & Biritch, on a long lease, a fishing station on the Kamchatka River (eastern shore of Kamchatka peninsula), and to S. Grooshetsky & Co. one on the Bolsha River (western shore of Kamchatka). In order to safeguard the fishery in the lease each was to build a fish hatchery with a capacity of 3,000,000 salmon per annum in the vicinity of the station. Each was to release 500,000 in 1914, 1,000,000 in 1915, and 3,000,000 yearly from 1916 to the end of the lease. Owing to technical difficulties only the latter firm built a hatchery, and this not until 1915 or 1916. It has since been shut down.

The development of the salmon and other fisheries of Siberia has been much hampered by the disinclination of the Russian Government to permit foreigners to acquire fishing concessions except on very short tenure. As the Russians themselves are generally unskilled in fishing operations, and are compelled to do the work with Russian labor, which is quite scarce, they do but little with their concessions. American capital would doubtless be available for developing Siberia's fisheries were it assured of a sufficiently long tenure of lease with some other minor concessions.

APPARATUS EMPLOYED.

In the river districts somewhat primitive fishing apparatus is employed. Spears, dip nets, and the other simple forms which seem to be common to all savage tribes depending upon the water for the greater part of their subsistence, are all in use by the natives living along the upper reaches.

Weirs of a primitive type known as "zaezdka," are also used. These have a lead consisting of willow poles and branches built from the river bank or a sand bank out into the stream. At the outer end is attached a net compartment with a lead, into which the fish, which have been following the lead in the search for an opening, pass. Two men in a boat are anchored close by, and as soon as 30 or 40 salmon have passed into the compartment, it is hauled up and the fish emptied into the boat, after which the net is reset.

Haul seines of varying lengths and depths are used in connection with the more important river fishing stations.

Along the coast the Japanese use a floating trap net somewhat similar to the type used in Alaska, also haul seines and a few gill nets.

ABUNDANCE OF SALMON.

It is exceedingly difficult to secure even approximate statistics of the Siberian catch of salmon, owing to the wide extent of coast, the totally inadequate means of transportation preventing close supervision, the presence of so many foreigners who go directly home with their catches at the end of the season, and the crude system of control in operation by the authorities.

The following table shows the catch of salmon in the four districts for the year 1898:

| District. | Spring. | Summer. | Autumn. |
|------------------|-----------|-----------|-----------|
| Nikolaevsk | | 7,464,896 | 4,685,480 |
| Okhotsk..... | 60,000 | 873,000 | 2,662,000 |
| Kamchatka..... | 1,067,000 | 316,950 | 665,500 |
| Sakhalin..... | 666,000 | 635,000 | 748,000 |
| Total..... | 1,793,000 | 9,289,846 | 8,760,980 |

In the Anadir district the catch in 1909 was as follows: Cape St. Michael, 91,616; above Cape Neuman, 8,234; Anadir River, 150,746; Anadir River estuary, 9,864; Hanchelar River, 6,121; Cape Observation, 270,000; total, 536,581. The catch by natives and small Russian fishermen is estimated at about 3,000,000 and 500,000 fish, respectively. In addition to this, 130 barrels of caviar, weighing 14 tons, were prepared, and there were 20 tons from Cape Observation.

According to the statistics of the Fisheries Control, the catch of salmon in the Amur River in 1910 was as follows: Spring salmon, 7,701,344; summer salmon, 21,384,549; autumn salmon, 9,546,254; in all, 38,632,147. Of this number 34,649,025 fish were marketed and the balance consumed locally. Japan bought 23,228,481 fish, valued at \$473,800; the balance was valued at \$681,345. In addition there were 4,766,784 pounds of salmon caviar, valued at an average price of \$0.114 per pound, totaling \$543,413, which brings the total value of the salmon catch and by-products up to \$1,698,558. During the same year, in Peter the Great Bay, 8,263 salmon were caught.

The number of salmon caught in eastern and western Kamchatka and in the bays and rivers in this region not included in the Fishing Convention, and at the Russian river stations, in 1911, was as follows:

| Species. | Western Kamchatka. | Eastern Kamchatka. | River stations. | Bays and river outlets. | Total. |
|--------------------------|--------------------|--------------------|-----------------|-------------------------|------------|
| Chavitch (king)..... | 5,421 | 7,818 | 207 | 590 | 14,036 |
| Keta (chum)..... | 3,082,300 | 2,675,000 | 297,300 | 890,790 | 6,945,390 |
| Krasnaia (red)..... | 2,136,800 | 747,000 | 689,000 | 236,240 | 3,809,040 |
| Garbusha (humpback)..... | 39,448,500 | 1,411,000 | 1,320,200 | 175,980 | 42,355,680 |
| Kishuteb (coho)..... | 327,200 | 179,000 | 114,200 | 7,770 | 628,170 |
| Total..... | 45,000,221 | 5,019,818 | 2,420,907 | 1,311,370 | 53,752,316 |

In the Okhotsk district the catch amounted to 827,274 keta and 37,790 krasnaia. Of salmon caviar 489 tons were prepared by the Japanese and 60 tons by the Russians.

In 1915 about 50,000 barrels of pickled salmon were prepared on the Amur River. In the sections covered by the Fishing Convention 6,000,000 salmon, mostly keta with a few krasnaia, were dry-salted, while 80,000,000 humpback salmon, called "salmon trout" in Japan, were so prepared. No fish were frozen for the European market, due to the war. A considerable quantity of caviar was prepared, but the quantity is unknown. The pack of canned salmon is shown elsewhere.

In the "Pacific Fisherman" (February, 1917), Seattle, Wash., its Hakodate (Japan) correspondent reports the following particulars of the 1916 salmon season:

During the year 1916 the salmon catches in the States of Kamchatka and Okhotsk, Siberia, varied greatly according to districts. On the west coast of Kamchatka and Okhotsk there was a big run all season, but the run on the east coast of Kamchatka was extremely poor, except in the Kamchatka River. The distribution of salmon varieties is always limited to about the following districts:

Chums are present in large quantities on the east coast of Kamchatka and Okhotsk, but on the west coast of Kamchatka they are never plentiful.

Red salmon are almost entirely limited to two districts, the Kamchatka and Ozer-naya rivers, being very scarce in other districts.

Humpbacks are found all along the coast, but most especially in the district of Boliskreska [Bolsheryetzk], where there is always a large run.

Silver salmon are found in small quantities on the west and east coasts of Kamchatka at certain seasons of every year.

King salmon are present in very limited quantities, early in the season on the west and east coasts of Kamchatka.

There were 17 canneries operated in 1916, and they packed about 470,000 cases. There were 218 fishing places on the shores, and the number of salmon caught during the season was 94,582,228.

All the salmon packers and fishermen in Siberia have used steamers for the transportation of their goods for several years past, but owing to the high rates now prevailing on steamer tonnage they were obliged again to make use of sailing vessels. Prices of all equipment and outfits for the canneries and salting stations were from 30 per cent to 50 per cent higher than for the previous year, but as a result of the strong demand for salmon products due to the European war, all the markets are in good condition. Accordingly, preparations for the coming season are expected to be on a more extensive scale, both as to number and size of canneries and development of the fisheries.

The above statement is accompanied by the following estimate of the number of salmon caught in 1916 in the States of Kamchatka and Okhotsk, except in the rivers:

| Species. | Okhotsk. | East Kam- chatka. | West Kam- chatka. | Total. |
|---------------|----------------|----------------------|----------------------|----------------|
| | <i>Number.</i> | <i>Number.</i> | <i>Number.</i> | <i>Number.</i> |
| Chum..... | 1,482,312 | 2,318,964 | 1,669,056 | 5,470,332 |
| Humpback..... | 3,710,320 | 1,776,112 | 79,926,512 | 85,412,944 |
| King..... | | 3,276 | | 3,276 |
| Red..... | | 308,502 | 3,311,304 | 3,619,806 |
| Silver..... | | | 75,870 | 75,870 |
| Total..... | 5,192,632 | 4,406,854 | 84,982,742 | 94,582,228 |

FREEZING SALMON.

As when the Russians owned Alaska, the exploitation of Siberia was carried on for many years by trading companies with large powers granted by the Government. In 1892 a very enterprising company was in charge, judging from the following extract from a letter written on February 2, 1893, by the late Eugene G. Blackford,

the well-known fish dealer of New York, to the late Col. Marshall McDonald, then United States Commissioner of Fish and Fisheries:

I have just learned of the arrival in Chicago of 60,000 pounds of frozen salmon. They were caught in Petropavlovsk, Kamchatka. These fish are a new venture undertaken by a commercial trading company who control that country, and these salmon have been taken from a river where none have been caught before, and my information is that they catch fish weighing as much as 150 pounds each. The above lot of fish was brought frozen to Tacoma and then shipped by refrigerator car to Chicago, where they were sold to Mr. Booth, of the Booth Packing Co., Chicago. Mr. Booth has declined to pay for them because of their not being in satisfactory condition.

Nothing further appears to have been done in this line until in 1903, when a Berlin fish merchant outfitted and sent to the Siberian coast a refrigerator steamer with a capacity of 2,500 tons. The fish were caught mainly in the Amur River and were frozen immediately after being brought aboard. In all, 160,000 salmon were obtained, and these were in excellent condition when landed at Hamburg, Germany.

In 1907 the Salmon Steam Fishing Co., a combined British and Japanese company, chartered the steamers *Zenobia* and *Zephyrus*. These vessels were fitted with refrigerating apparatus and cold-storage chambers and sent to the Kamchatkan Peninsula to get a cargo. Both secured good cargoes.

In 1909 two refrigerating steamers visited the coast and froze salmon for the European market. One vessel was outfitted by a British company and the other by a German company, J. Lindenberg (Inc.). The latter reported that the dog salmon, the principal species frozen, were large and very bright. The British steamer left England in April and arrived home again late in December.

CANNING SALMON.

In 1900 the Kamchatka Commercial & Industrial Co. (Ltd.), was organized at St. Petersburg, Russia, by A. T. Prozoraf, president of the St. Petersburg Chamber of Commerce; P. M. Grunwalt; H. T. M. Court, and A. A. Prozoraf, secretary. A complete canning outfit was purchased in the United States, and the first cannery in Siberia established at Petropavlovsk, Avacha Bay, Kamchatka.

The San Francisco Trade Journal, under date of December 19, 1902, printed the following item relating to the operations of this cannery:

On December 8 the Russian barkentine *Bitte* arrived from Petropavlovsk, Siberia, with 10,136 cases canned salmon. This is the first consignment of salmon received from them.

The greater part of the pack comprised dog salmon, although they were labeled "pink" salmon, the rest being reds and kings.

In 1903 the company did not operate, the fishing season being devoted to moving the plant to Ust-Kamchatka, at the mouth of the Kamchatka River, where, after being in use altogether for two or three years, it was abandoned and left all standing.

In 1907 two canneries were established in the estuary of the Amur River, near Nikolaevsk, but beyond getting out samples they were never operated.

In 1910 A. G. Denbigh, an Englishman, built a modern cannery near the second site of the Kamchatkan Commercial & Industrial Co. That year the cannery produced only about 10,000 cases, but each year since the equipment of the plant has been enlarged and improved until in 1913 the pack amounted to 60,000 cases. Early in 1914 a

complete two-line plant of American can-packing machinery was installed.

In 1912 Mr. Denbigh built another cannery $1\frac{1}{2}$ miles away from the above plant. This plant was first operated with German and Norwegian sanitary machinery, but in 1914 a two-line American sanitary can-packing plant was installed, the can-making plant at the first plant making all the cans needed at the two canneries.

In 1915 a number of additions were made to both plants in the line of flat fillers, etc., while still more were in contemplation for 1916.

Mr. Denbigh also operates a hand cannery at Kompakova, on the west side of the Kamchatka Peninsula.

Up to 1912 very few canneries, and these very primitive affairs, had been built by the Japanese, owing to the uncertainty of tenure referred to previously. The "canneries" were mere sheds or shelters where the cans—which were brought from Japan, made or half made—were filled, closed, and cooked, furnace-heated, vertical retorts being used for the latter purpose. If the owner lost his concession at the end of the fishing season he simply took his retorts away with him and the buildings were left to his successor.

In 1912 a Tokyo company (Ichigumi & Co.) put up two canneries near the Ozernaya River in Kamchatka, while a Japanese from Niigata, Japan, also put up a small plant in the same vicinity. Both plants were cheaply built and operated with hand-power machinery and small vertical retorts. That year the two companies together packed about 13,500 cases of salmon.

The same season Ichigumi & Co. put up another hand-power cannery, and Tsutsumi & Co., of Hakodate, Japan, built two others of the same type near the Kamchatka River, on the east coast.

In 1913 Tsutsumi & Co. built a modern cannery at Ozernaya and installed a complete line of American sanitary can-making and can-packing machinery.

The same year Ichigumi & Co. put up two hand-power canneries near the Kamchatka River, having succeeded to the concessions formerly held here by Tsutsumi & Co. In 1914 they built a modern plant and installed a complete line of American sanitary can-making and can-packing machinery.

The St. Petersburg firm of S. Groshetsky & Co., which has been engaged for a number of years in the freezing of salmon and in the preparation of salmon caviar, under the name of the Pacific Ocean Sea Industry Association, erected a cannery near Ozernaya in 1914, and installed in it a full line of American sanitary can-making and can-packing machinery. This plant will compare favorably with most of our Alaska canneries. The buildings are of iron.

In 1915 a number of extensive improvements in the way of new buildings, machinery, etc., were made to the various plants, and during the winter of 1915-16 several of the canning firms had representatives in this country selecting much additional machinery for use during the 1916 season. During the latter season Tsutsumi & Co. erected a large new plant at Kiseka and a one-line plant above Kiseka. This company also operates a can-making plant at Hakodate, equipped with American Can Co. machinery and with a capacity of 800,000 cans per day. Owing to the heavy demand, caused by the war, a number of small hand-pack canneries also operated.

In 1917 A. G. Denbigh built a cannery at Javino, on the west coast of Kamchatka Peninsula. All the machinery in this plant is electric driven.

In 1918 the ravages occasioned by the war so far as personnel, transportation, tinplate shortage, and market conditions were concerned had come to a head, and as a result the Grooshetsky & Co. and some of the smaller canneries did not operate, while Tsutsumi & Co. operated only those of its canneries which packed red salmon.

In 1919 conditions were much more favorable in Siberia, and as a result the three Russian plants which were shut down in 1918 reopened. Tsutsumi & Co. erected and operated a new cannery in Ust-Kamchatka. The Nichiro Gyogyo Kabushi Kaisha, or Russo-Japanese Fisheries Co. (Ltd.), built and operated two additional one-line canneries at Kompakova and Kiseka.

The following table shows the detailed pack of canned salmon made by the various companies operating in Siberia in 1915:

SIBERIA CANNED SALMON PACK IN 1915.^a

| Name and cannery location. ^b | Canneries. | One-pound flats. | | | | | Total. |
|---|------------|-------------------------|------------------------|-------------------------|-------------------------|------------------------|--------------------------|
| | | Reds. | Springs. | Silvers. | Chums. ^c | Flump-backs. | |
| A. G. Denbigh, Kamchatka River (2) and Kompakova..... | 3 | <i>Cases.</i> 58,000 | <i>Cases.</i> | <i>Cases.</i> 26,000 | <i>Cases.</i> 38,000 | <i>Cases.</i> | <i>Cases.</i> 122,000 |
| Food Products Exp. Co. | 4 | <i>d</i> 35,000 | ..... | ..... | ..... | ..... | 35,000 |
| S. Grooshetsky & Co., Bolsheryetzk .. | 1 | 6,000 | ..... | ..... | 23,000 | ..... | 29,000 |
| Minard & Co. | 1 | ..... | ..... | ..... | 7,000 | ..... | 7,000 |
| Nichiro Fishing Co. (Ltd.), Kamchatka River..... | 1 | 14,703 | 3,334 | 2,191 | 11,981 | ..... | 32,209 |
| Sugamiya..... | 1 | 2,200 | ..... | ..... | ..... | ..... | 2,200 |
| Tsutsumi & Co., Ozernaya..... | 1 | <i>e</i> 37,800 | ..... | ..... | 8,800 | ..... | 46,600 |
| Hand-pack canneries, East and West Kamchatka..... | 2 | 1,000 | ..... | ..... | 4,000 | 10,000 | 15,000 |
| Total..... | 10 | 154,703 | 3,334 | 28,191 | 92,781 | 10,000 | 289,009 |

^a From Pacific Fisherman Yearbook for 1916, p. 44.

^b There were also a couple of small canneries operated on the Amur River which are not shown here.

^c Called "Pinks" in Siberia.

^d Includes 10,000 cases one-half pound flats of 8 dozen each.

^e Includes 10,800 cases one-half pound flats of 8 dozen each.

In order to show the changes which have occurred since 1915 the detailed pack made by the various companies for 1919 is given.

SIBERIA CANNED SALMON PACK IN 1919.^a

| Name. | Cannery location. | Number of canneries operated. | Spring. | Red. | | | |
|--|--|-------------------------------|--------------|--------------|--------------|--------------|--------------|
| | | | 1-lb. flats. | 1-lb. tails. | 1-lb. flats. | 1-lb. flats. | 1-lb. flats. |
| Grooshetsky, S., & Co..... | Ozernaya, Bolsheryetzk..... | 2 | ..... | ..... | 8,363 | ..... | ..... |
| Hakama, S., & Co..... | Opala..... | 1 | ..... | ..... | 7,550 | ..... | ..... |
| Hokuyo-Gyogyo Kabushiki Kaisha (Ltd.)..... | Ust-Kamchatka ^b | 2 | ..... | ..... | 73,058 | ..... | ..... |
| Nichiro Gyogyo Kabushiki Kaisha (Ltd.)..... | Bolsheryetzk, Opala, and Ust-Kamchatka..... | 3 | 1,533 | ..... | 56,877 | ..... | ..... |
| Shindo, S., & Co..... | Narachesky..... | 1 | ..... | ..... | 888 | ..... | ..... |
| Suda, K., & Co..... | Palana R..... | 1 | ..... | ..... | 900 | ..... | ..... |
| Tsutsumi & Co..... | Ust-Kamchatka, Ozernaya, Javino, Koshegochinsky, Bolsheryetzk (2), and Kuftoi..... | 7 | 3,575 | 557 | 112,396 | ..... | 18,266 |
| Zushutsu-Shokuhin Kabushiki Kaisha (Ltd.)..... | Opala Goluginsky, Koshegochinsky, Javino ^c | 4 | ..... | ..... | 80,832 | ..... | 17,604 |
| Total..... | ..... | 21 | 5,108 | 557 | 340,863 | ..... | 35,870 |

^a From Pacific Fisherman Yearbook for 1920, p. 86.

^b Formerly Denbigh canneries at Nerpihr and Seaside.

^c Javino cannery bought from A. G. Denbigh & Co.

SIBERIA CANNED SALMON PACK IN 1919—Continued.

| Name. | Cannery location. | Silver. | | Chum. | Humpback. | | Total. |
|--|---|--------------|--------------|--------------|--------------|--------------|-------------|
| | | 1-lb. talls. | 1-lb. flats. | 1-lb. flats. | 1-lb. talls. | 1-lb. flats. | Full cases. |
| Grooshetsky, S., & Co.... | Ozernaya, Bolsheryetzk.. | ..... | 5,337 | ..... | ..... | 20,248 | 33,948 |
| Hakama, S., & Co..... | Opala..... | ..... | ..... | ..... | ..... | 7,550 | 7,550 |
| Hokuyo-Gyogyo Kabu- shiki Kaisha (Ltd.). | Ust-Kamchatka ^a..... | ..... | 31,484 | 78,589 | ..... | ..... | 183,131 |
| Nichiro Gyogyo Kabu- shiki Kaisha (Ltd.). | Bolsheryetzk, Opala, and Ust-Kamchatka. | ..... | 20,941 | 11,018 | ..... | 12,200 | 102,569 |
| Shindo, S., & Co..... | Narachefsky..... | ..... | 177 | ..... | ..... | ..... | 1,065 |
| Suda, K., & Co..... | Palana R..... | ..... | ..... | ..... | ..... | 900 | 900 |
| Tsutsumi & Co..... | Ust - Kamchatka, Ozer- naya, Javino, Koshego- chinsky, Bolsheryetzk (2), and Kuftoi. | 17,909 | 30,516 | 12,376 | 50,027 | 60,807 | 306,429 |
| Yushutsu-Shokuhin Kabushiki Kaisha (Ltd.). | Opala, Golniginsky, Ko- shegichinsky, Javino. ^b | ..... | ..... | ..... | ..... | 14,484 | 112,920 |
| Total..... | ..... | 17,909 | 88,455 | 101,983 | 50,027 | 107,739 | 748,512 |

^a Formerly Denbigh canneries at Nerpichr and Seaside.^b Javino cannery bought from A. G. Denbigh & Co.

The following table shows the pack of canned salmon in Siberia from 1910, the virtual inception of the industry, to 1919, inclusive:

| Year. | Canneries operated. | Reds. | Silvers. | Pinks, or dogs. ^a | Springs. | Hump- backs. | Total. |
|------------|------------------------|---------------|---------------|---------------------------------|---------------|-----------------|--------------------|
| | | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Full cases.</i> |
| 1910..... | 1 | 5,500 | 2,500 | 2,000 | ..... | ..... | 10,000 |
| 1911..... | 1 | 15,000 | 6,000 | 4,000 | ..... | ..... | 25,000 |
| 1912..... | ..... | 43,500 | 18,000 | 16,000 | ..... | ..... | 77,500 |
| 1913..... | ..... | 102,900 | 7,000 | 21,000 | ..... | 2,500 | 133,400 |
| 1914..... | ..... | 85,000 | 22,500 | 27,000 | ..... | 2,000 | 136,500 |
| 1915..... | 10 | 119,703 | 28,191 | 92,781 | 3,334 | 10,000 | 254,009 |
| 1916..... | 18 | 229,406 | 54,652 | 129,598 | 2,047 | 56,064 | 471,767 |
| 1917..... | 18 | 275,212 | 29,980 | 66,056 | 2,556 | 137,197 | 511,001 |
| 1918..... | 15 | 296,960 | 43,588 | 23,585 | 2,027 | 15,177 | 341,337 |
| 1919..... | 21 | 377,290 | 106,364 | 101,983 | 5,108 | 157,766 | 743,512 |
| Total..... | ..... | 1,553,471 | 318,775 | 484,003 | 15,072 | 380,704 | 2,749,026 |

^a Dog salmon are marketed under a "pink" label.

SALTING SALMON.

By far the greater part of the salmon catch of Siberia is either pickled or dry salted. This was the earliest commercial method initiated on the coast and has been followed for a number of years, mainly by the Japanese. The coast is dotted with concessions worked by Japanese, while there are large numbers in operation along the rivers, these being restricted to Russians. An idea of the extent of this branch of the industry may be gathered when it is stated that in 1915 there were 50,000 barrels of pickled salmon prepared in the Amur region, while the Japanese dry salted about 6,000,000 dog salmon, including also a few reds, and 80,000,000 humpbacks, or "salmon trout," as they are called in Japan.

In pickling salmon the fish are split down the back, the sides being held together by the belly. The roe, gills, and viscera are removed and the fish are then washed, and after salting are placed in large

tanks for seven or more days, or until they are thoroughly struck, after which they are packed in barrels, flesh side up, except the two top layers, which have the skin side up. To about 700 pounds of fish 180 pounds of salt are used.

The dry salting, next to drying, is the most primitive method employed in preserving salmon. The process consists simply in splitting the fish up the belly, removing the gills and entrails, and then filling the belly with salt. The fish are then placed in rows on matting and covered with salt, and other rows are placed on top of them until the pile is from 8 to 10 feet high, when the entire lot is covered with matting and left for about seven days, after which they are relaid and again covered with salt. For shipping, the fish are packed in mats.

A very odd feature in connection with the operation of most of the Japanese plants is that the salt to be used in curing the fish is usually dumped loose onto some level spot, with absolutely no covering over it, and exposed to the elements.

The Japanese consume enormous quantities of these dry-salted salmon. During the Russian-Japanese war the latter country's fishermen were cut off from access to their usual fishing grounds, with the result that they were forced to look elsewhere for fish. During 1905 and 1906 large quantities were prepared in Alaska, British Columbia, and Washington for this trade, but as soon as the war ended and the Japanese got access once more to their old fishing grounds, the Japanese duty on salt fish, which had been suspended during and for a short period after the war, was reimposed. As a result our fishermen soon quit the business, and since then operations on this coast have been almost wholly restricted to Japanese operating in British Columbia waters.

At the height of the production on this coast Mr. King, the American consular agent at Hakodate, Japan, made the following suggestions to preparers and shippers of dry-salted salmon for the Japanese trade:

The salmon should arrive in Japan by December 1. Most of these fish are used among the Japanese for New Year's presents. After the new year the price invariably declines 20 to 30 per cent, and for a month or two the fish are difficult to dispose of, as the consumers always stock up before the new year.

The salmon should weigh not less than 5 pounds when thoroughly cured. They should be free from spots, which are usually found on the salmon if caught in fresh or brackish water. No Japanese would think of giving a salmon with red and black spots to a friend for a New Year's present, and spotted fish never realize more than half the price obtainable for clean white fish. The salmon should be split up the belly and should be salted with fine salt. Coarse salt always tears the flesh of the fish when being rubbed in. Care should be taken that the salmon are not oversalted.

Semga salting is a more improved and sanitary method than that of straight pickling and is used when the fish are being prepared for the European market. Selected fish are cut open along the belly and the viscera and gills are carefully removed. In order that the salt may penetrate the flesh more thoroughly, the flesh on the inside is scored several times. The fish are then carefully washed and rubbed with brushes, after which they are kept on ice for 24 hours. The brine is carefully prepared and very strong. When properly struck the fish are repacked into barrels.

"Kolodka" is a very crude and cheap method of salting. The fish are half salted and half dried without being cut open, and are sold at the place where prepared.

The natives prepare a great many salmon for the winter use of themselves and their dogs, the same as do the Alaskan natives. The fish are dried without the use of salt. The product is known as "youkala."

Some salmon bellies are also cut out and salted, although this has never attained to prominence.

Some fresh salmon, as well as salted, are smoked for local consumption.

Barrels, or tierces, for packing salmon are made from cedar, larch, or fir, with a net capacity of 900 to 1,000 pounds of fish, and are bound with wooden and iron hoops.

THE SALMON FISHERIES OF JAPAN.

Outside of Karafuto (that portion of Sakhalin Island, south of 50° north latitude, which belongs to Japan) and the Kuril Islands, the salmon fisheries of Japan are comparatively small, the principal portion of the immense catches made by Japanese fishermen being along the coasts of Siberia and Karafuto.

All of the five species of salmon found on the American side are to be found in the waters of Sakhalin during the usual spawning periods.

The dog salmon (*O. keta*), which is known in Japan as "sake," and when canned as "pink" salmon, is to be found on Hokushu Island, running up the various streams for spawning purposes from September to December.

On the same island is to be found also the masu (*O. masou*), a salmon, according to Dr. Jordan,^a very similar to the humpback, the scales being a little larger, the caudal fin without black spots, and the back usually immaculate. It is fairly abundant in the streams of Kokushu, the island formerly known as Yezo, and is found nowhere else in the world. The author had an opportunity to examine a dry-salted masu (it might be well to state here that in Japanese masu means "trout") at the fish house of the Royal Fish Co., in Vancouver, British Columbia, in January, 1916. The manager, Mr. Emy, had imported the fish from his own country. Both in size and general appearance it closely resembled a humpback salmon, and when cut open the flesh had the same coloring observable in our humpback. This species, and the true humpback found in more northern waters, especially in Siberia, are dry salted in immense numbers and are generally marketed under the name of "white trout" or "salmon trout."

In Japan the "red trout" seem to be our rainbow and brook trouts, which were introduced into Japanese waters some years ago. The red salmon (*O. nerka*) is to be found landlocked in Lake Akan in the northern part of the island. It is smaller in size than the sea species. This species has been introduced into the waters of Honshu.

The section of this report devoted to the salmon fisheries of Siberia treats quite fully of the activities of the Japanese in that quarter.

^a Fishes, p. 296. By David Starr Jordan. N. Y., 1907.

In Sakhalin, or Karafuto, as it is called in Japan, the Japanese have had a rather checkered career. At one time this island belonged to the Chinese Empire. Early in the nineteenth century the southern portion was occupied by the Japanese. In 1875 she bartered it to Russia in exchange for some small islands in the Kuril group. As a result of the Russo-Japanese war the southern half, or all that portion south of 50° north latitude, was in 1905 ceded to Japan.

The salmon fisheries of this island are of much importance. For many years the Japanese had a virtual monopoly of them, but very early in the present century the Russians attempted to restrict considerably the activities of the Japanese fishermen, and encouraged her own subjects to compete with them. Many hundreds of Russians and Koreans were encouraged to migrate to the island and engage in its fisheries. Despite these handicaps, the operations of the Japanese fishermen, according to the statistics shown below, do not seem to have suffered.

| Year. | Salmon. ^a | Spring salmon. | Total. |
|-----------|---------------------------|---------------------------|---------------------------|
| | <i>Koku.</i> ^b | <i>Koku.</i> ^b | <i>Koku.</i> ^b |
| 1897..... | 8,589 | 34,246 | 42,835 |
| 1898..... | 6,335 | 11,228 | 17,563 |
| 1899..... | 8,379 | 22,959 | 31,338 |
| 1900..... | 7,719 | 8,797 | 16,516 |
| 1901..... | 3,089 | 12,735 | 15,824 |
| 1902..... | | | 24,726 |

^a Species not specified.

^b Koku equals about 5½ bushels.

Considerable fishing is carried on around the island of Yotorofu, one of the Kuril group. Here are found red (*O. nerka*), silver (*O. kisutch*), and dog salmon (*O. keta*), also either the humpback or Dr. Jordan's masu.

CANNING INDUSTRY.

The salmon canning industry in Japan proper was inaugurated by the Hokushu Colonization Department, a local branch of the Federal Government. For some time this department had operated a fishery school on Hokushu Island, at which experimental work in the canning of salmon and other fishery products was carried on. This establishment canned considerable salmon during the Russo-Japanese war.

This same department also established a fishery school on Yotorofu Island, one of the Kuril group, which was, in 1908, taken over by Suhara Kakubei, a fisherman and graduate of the school, and used as a salmon cannery.

Some years earlier, however, about 1892 or 1893, Fujino Shirobei started canneries in Shibetsu and Bekkai, Nemuro Province, Hokushu Island, and a short time later Idzumi Shozo also started a plant at Nemuro. For a number of years these three canneries were the only producers. The plants were quite primitive, the product small, and most of it was consumed by the Japanese navy. A demand for the product was gradually worked up, however, and as a result there are now a number of small canning plants on Hokushu Island proper, the Kuril Islands, and Japanese Sakhalin. Most of these plants devote the major part of their energies to the packing

of crab meat, the canning of salmon being in most cases a side issue. A few of the plants have been equipped with machinery, but the large majority are hand-pack plants, employing but a few persons.

Most of these plants pack what is called "white trout," which is really the humpback or masu salmon. In 1912 there were in Hokushu and adjacent islands 21 canneries which packed 730 cases (48 one-pound flat cans each) of red (*O. nerka*) and 72,770 cases (48 one-pound cans each) of "white trout," a total of 73,500 cases.

On the Japanese portion of Sakhalin Island 4 canneries packed 10,120 cases (48 one-pound cans each) of "white trout" in 1912.

The pack of canned salmon in Japanese territory in recent years has been as follows:

| Year. | Hokkaido and Kurils. | Karafuto (Japanese Sakhalin). | Total. |
|-----------|----------------------------|-------------------------------------|---------------|
| | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> |
| 1912..... | 73,500 | 10,120 | 83,620 |
| 1913..... | 46,000 | ..... | 46,000 |
| 1914..... | 50,450 | 15,000 | 65,450 |
| 1915..... | 55,000 | 15,000 | 70,000 |
| 1916..... | 37,800 | 1,800 | 39,600 |
| 1917..... | 39,545 | 16,607 | 56,152 |
| 1918..... | 21,490 | 5,000 | 26,490 |
| 1919..... | 50,500 | 18,000 | a 68,500 |

a Composed of 2,500 cases of 1-pound flat red salmon and 66,000 cases of 1-pound flat chum salmon.

The following table shows the quantities and value of salmon and trout taken by the Japanese fishermen in certain years:

| Year. | Salmon. | | Trout | |
|-----------|------------|-----------|------------|---------|
| | Pounds. | Yen. | Pounds. | Yen. |
| 1902..... | 5,722,475 | 454,662 | 923,025 | 121,499 |
| 1907..... | 9,286,267 | 892,879 | 4,500,008 | 332,316 |
| 1912..... | 26,438,017 | 1,594,230 | 44,038,383 | 928,513 |

FISHERY METHODS.

In Japanese waters salmon are taken by means of trap nets, haul seines, and gill nets.

The haul seines used along the seashore have a length of about 500 fathoms. Each is carried by a boat of 9 feet beam with 30 men, and the right wing, called the "outing wing," is first paid out as the boat heads out from the beach. When the pocket, or bunt, is cast the boat turns its course toward the right and steers gradually landward, casting the left wing. When the school is encircled the seine is hauled ashore by the seine ropes.

The floating trap net used for salmon is known as "kaku-ami," or square trap net. This consists of a main net and lead. The main net, or heart, is 70 fathoms long, 10 fathoms wide, and 10 fathoms deep, and the lead is 120 fathoms long. The latter guides the fish toward the main net. When being fished the pot is hauled up by a boat crew and the fish transferred to the boat by means of a dip net.

FISH CULTURE.

The artificial culture of salmon is carried on in 56 hatcheries, which are distributed in Hokkaido and the prefectures of Aomori, Akita, Yamagata, Niigata, Toyama, Kyoto, Iwate, and Miyagi. Nine of these belong to the government of Hokkaido and other prefectures, while the rest are owned by fishing associations, individuals, or corporations. The number of young salmon distributed by these hatcheries amounts to over 80,000,000 a year.

The largest hatchery is the one at Chitose, under the supervision of the Hokkaido Fishery Experimental Station. It was established in 1887, and it is estimated that the fish distributed by it number from 20,000,000 to 30,000,000 yearly.

The salmon hatchery of Murakami, Niigata prefecture, dates as far back as 1881, when a regulation pertaining to the preservation of young salmon in the River Miomote was enacted by the prefecture of Niigata. This was first called the "Murakami Salmon Raising Plant," but in 1891 it was turned into a hatchery, and is now distributing 2,000,000 young salmon a year. The salmon hatchery of Nitta River, Fukushima prefecture, is very similar in its history and organization to the above.

The industry has during the last few years become very popular in Yamagata prefecture, where 22 hatcheries are in operation as private enterprises.

In the prefectures of Shiga, Miye, Shizuoka, Nagano, Yamanashi, Kanagawa, Akita, Niigata, Hyogo, Miyazaki, and Hokkaido, the masu (*O. masou*) and the landlocked hime-masu (*O. nerka*) are raised and distributed in the lakes and rivers. There are eight hatcheries working on these species. The hatchery of Lake Towada, Akita prefecture, first transplanted hime-masu from Hokkaido in 1902, and it is now hatching from 5,000,000 to 10,000,000 eggs a year for the purpose of distributing the fish among the different districts.



IMPROVEMENTS IN PROCESS OF SALTING RIVER HERRING, ESPECIALLY ADAPTED TO WARM CLIMATES.¹

By HARDEN F. TAYLOR, *Technologist, U. S. Bureau of Fisheries.*

Contribution from the Fishery Products Laboratory, Washington, D. C.

INTRODUCTION.

In the warmer parts of the United States it has generally proved to be difficult, if not impossible, to preserve certain kinds of fish by salting, though some kinds appear to be more difficult of preservation than others. The reason for failure was believed to be that at warm temperatures the fish spoils before the salt penetrates to the innermost parts: this belief was verified experimentally in an investigation² in which several improvements in the process of salting alewives or river herring were evolved. No doubt these improvements are applicable also to other kinds of fish. As will be seen below, none of them are really new, but well known procedures were studied chemically and variations which gave best results were followed in every case, so that the process is very much more successful under adverse conditions, and the final product is superior in quality.

While the procedure herein described has been quite successful in a small way, it will be understood by all cautious persons that no unusual methods should be applied on a large scale until their practicability has been thoroughly established by commercial application. In Florida some 80,000 river herring, or alewives, were salted under the supervision of this Bureau in the 1920 season. These were marketed at a good price, and no complaints were lodged with the producers, so far as known. It therefore seems proper to make available in practicable form the details of the process employed for those who care to try it.

As stated above, the difficulty in salting fish in warm climates seemed to be due to slow penetration of salt and rapid decomposition of the fish. Obviously, then, any procedure that hastens penetration of salt and retards decomposition of fish should improve the prospects of success. A number of simple and practicable ways of doing both of these things were found. For example, it was found that calcium, or lime, and magnesium, the common impurities in salts used commercially, retard penetration altogether out of proportion to the quantities present. A salt consisting of 4.7 parts of magnesium

¹ Appendix II to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. No. 903.

² For original chemical and scientific data on which this paper is based, see "Some Considerations Concerning the Salting of Fish," by Donald K. Tressler, B. F. Doc. No. 884, Appendix V, Report, U. S. Commissioner of Fisheries for 1919.

chloride and 95.3 parts of pure salt required five days to penetrate fish to the extent that pure salt did in three days; and the same salt required nine days to penetrate as far as pure salt did in four and one-half days. It was found that salt applied dry to fish penetrated fish as deeply in five days as saturated brine did in eight days. It was found that blood spoiled at a lower temperature than fish flesh, and that fish containing blood, roe, and milt spoiled at about 65° F., while thoroughly cleaned fish could be salted successfully at 90° or even 100° F. It remained, therefore, only to take advantage of these principles and to apply certain facts already known from other sources to hasten penetration of salt and retard decomposition of fish until they are preserved.

PRINCIPLES OF IMPROVED PROCESS.

The principles will now be taken up and discussed in such a way that by following in detail the method outlined it is believed any person can carry them successfully into practice. The principles are:

1. Careful handling of fish before salting.
2. Thorough cleaning, especially removal of all blood.
3. Use of salt of a high degree of purity.
4. Application of salt in the dry condition.

To these should be added—if the fish are to be stored for any considerable length of time—storage of fish in brine. (There is considerable doubt of the feasibility of storing salt fish in very warm climates; until this subject is investigated it seems advisable to hold only in cool storage.)

These principles are known, at least in part, to many experienced salters of fish, yet the combination of them all is rarely or never followed. The great difference that is made in the quality of salt fish by following them will be readily observed upon comparing the product with that of ordinary processes.

1. CAREFUL HANDLING OF FISH BEFORE SALTING.—Two precautions are particularly important under this head, namely, to avoid bruises and to avoid warmth. Bruises promote decomposition of fish in the same way that they cause fruits to rot. Therefore, fish should not be forked, walked on, squeezed when taken from nets, nor packed deep in boats, boxes, or barrels, and care should be exercised to see that they are not crushed or bruised by large chunks of ice. Warmth, as every fisherman knows, hastens decomposition. It is best to put the fish in finely crushed ice immediately after capture, but if not so treated they should be kept as cool as possible and should be salted with the least possible delay. It is well to remember that fish are of about the same temperature as that of the water from which they come, and therefore fish taken from warm water should be handled more expeditiously than those from cold water. Fish should be shielded from direct sunlight and should not be allowed to dry, as the skin shrinks and loses its luster if dried.

2. THOROUGH CLEANING, ESPECIALLY REMOVAL OF ALL BLOOD.—It has been found in the case of river herring that blood spoils at a much lower temperature than flesh. These fish can be salted at from 90° to 100° F. or higher if the blood is all removed, while those containing

blood will sour if salted at 65° F. In cool climates the blood may be left in the fish if desired, as it imparts a distinct flavor, for example, in the Scotch method of curing herring. But in warm climates, where conditions are unfavorable at best, there is no choice but to remove every trace of blood as well as all entrails and roe and the head. To do this it is necessary to behead the fish, take out entrails, scrape the kidney out (the bloody strip lying under the backbone), and wash the fish thoroughly. (A 20-penny wire nail, the head of which has been sharpened with a file, makes a convenient instrument for scraping out the kidney.) Large fish may be split through the back and laid open. The washing should preferably be done by rousing the fish in brine of about the strength of sea water, but it may be done in cold fresh water. In the case of alewives or river herring, the washing operation should also serve to remove scales by vigorous rousing. It may seem that if the blood spoils at 65° F. the meat of the fish would not necessarily be ruined. But the taint of spoiled blood is sufficient to make the entire fish unfit for food. It is also probable that the presence of blood may initiate a kind of decomposition of the flesh.

3. USE OF SALT OF A HIGH DEGREE OF PURITY.—This is the most important factor in salting fish in warm climates; yet some people are inclined to question the truth of this statement. Fishermen generally have no first-hand way of knowing whether or not any particular lot of salt is pure, as neither the looks of salt nor the claims of advertising matter are always reliable indications of purity. By purity is meant not cleanness but the scarcity of foreign substance in the salt. Salt may be highly impure yet perfectly white and very fine and clean, for the two most objectionable impurities, lime and magnesium salts, are white, like salt. On the other hand, salt may be dirty or colored, and yet if lime and magnesium salts are absent may penetrate and preserve the fish.

It is therefore necessary to have a salt of a very high degree of purity; that is, with less than 1 per cent total impurity. There are grades of salt on the market containing a total of less than one-tenth of 1 per cent impurity.¹ These salts are especially suitable for salting fish by this method. Chemical analysis is the only reliable guide to purity; most reliable dealers are able to give the correct analyses of their brands of salt, and these figures should be required before purchase. The figures for sodium chloride (pure salt) should be 99 per cent or over—the higher the better, 99.96 per cent sometimes appearing. The figures for calcium (lime) and magnesium salts should be as low as possible. It makes little difference whether they are sulphates or chlorides, any salt in which calcium and magnesium taken together are more than 1 per cent should be looked upon with suspicion for salting fish in warm climates.

The presence of moisture does not cause the salt to be unsuitable. If moisture is present, as it usually is, allowance should be made for it; pure salt (sodium chloride) and moisture added together should

¹ Names of manufacturers of satisfactory brands of salt will be supplied on application to this Bureau; also if analysis of a salt is furnished, the Bureau will, upon request, give opinion as to its suitability for curing fish.

exceed 99 per cent. The following example will illustrate the point. A chemical analysis of some lot of salt is, let us say:

| | Per cent. |
|-------------------------|-----------|
| Sodium chloride----- | 97.50 |
| Moisture----- | 2.00 |
| Magnesium chloride----- | .25 |
| Calcium sulphate----- | .25 |
| Total----- | 100.00 |

This analysis shows only 97.5 per cent pure salt—which might not appear suitable for fish. But allowance must be made for the harmless moisture present. Strictly calculated, after this allowance is made, there is found to be 99.49 per cent pure salt; practically the same result (though not absolutely correct), 99.50 per cent is the sum of pure salt and moisture. The sample is therefore very pure and suitable for salting fish.

Calcium and magnesium in salt, even in small quantities, greatly retard penetration, so much so that in warm weather the fish may spoil before the salt strikes through. But in cold weather in northern climates salt containing considerable quantities of these substances may be used successfully. It will be noted by those who use highly purified salt that the fish do not become white and firm as they do with ordinary Turks Island, Trapani, or other crude salt. The lime and magnesia have a hardening effect on fish, and they whiten the flesh by coagulating it, as heat whitens the white of egg. Nevertheless, the somewhat yellowish, soft fish, produced in pure salt is equally as well preserved as the hard fish in crude salt, is milder and richer in flavor, and soaks out more quickly. This may be somewhat difficult to introduce in a market that has been accustomed to a hard, white fish, but the consuming public should not be long in discerning the superiority once the purer fish is distributed.

It may be objected that pure salt is too expensive. The crude salt may be, let us say, \$10 per ton and pure salt \$25, a difference of \$15 per ton more for the pure grade. Fifteen dollars per ton is three-fourths of a cent per pound; about 35 pounds of salt will suffice for 100 pounds of fish. The difference in cost for salt is therefore about 27 cents per 100 pounds of fish, or one-fourth of a cent per pound on the basis of the above assumption. The loss of a few barrels of fish (including the labor that was put upon them) will cover the cost of a large pile of pure salt. In very warm climates, in salting river herring, pure salt is necessary to safety.

4. APPLICATION OF SALT IN THE DRY CONDITION.—There is very extensive business in both dry salting and brine salting or pickling fish. In the case being considered, where the greatest speed of penetration is necessary, the dry salt must be used, for, applied in this way, it penetrates much faster than brine. Again, the fisherman fortunately located in a cool country may follow his discretion, but the fisherman who works under the handicap of a warm climate will find it necessary to use the salt dry.

About 35 pounds of salt to each 100 pounds of fish is sufficient, if well distributed. The fish should be rolled in the salt (which should be fine grained), the belly cavities filled, and the fish packed backs down in tubs so as to hold the salt until it dissolves. These tubs may be made by sawing barrels in two in the middle. A weight should be

placed on the fish to keep them from floating, but not sufficient to press or crush the fish. If barrels are used they should not be filled at first, as the pressure will be too great on the fish at the bottom, but after the fish are struck through barrels may be packed full.

The reason for using dry salt is not difficult to see. It is the brine or salt immediately in contact with the fish that acts on the fish. If brine is used, the water coming from the fish dilutes it and it rapidly becomes less effective unless the fish are continuously stirred; but if dry salt is used, the water coming out of the fish immediately becomes saturated with salt, so that the brine in contact with the fish is saturated at all times.

If the brine is warm, the fish may be struck through in less than 24 hours, but ample time should be allowed. It appears that the warmer the brine, the faster it penetrates; and also the faster the fish spoils; there should be therefore some temperature which would give the most rapid penetration without excessive decomposition, but this temperature has not been determined. One soon learns to tell by the appearance of fish after it is broken through the backbone whether or not it is struck through.

SHIPPING OR STORAGE OF FISH IN BRINE.—If for immediate market, the fish may be taken from the brine and shipped at once. This involves draining off the brine, applying some more dry salt, packing the fish in sugar barrels or other containers, and shipping. In this condition the herring are excellent, but will not keep long, as the fat will rust and become rancid. In case the fish are to be held for a period of weeks or months, it will be necessary to keep them under brine at all times for the purpose of excluding air which causes the fat to rust. They should be allowed to remain in their original brine, strong, tight barrels being used. The barrels should be quite full of fish, and there should be a slight excess of undissolved salt. The barrel should be tightly headed, turned on its side, and nearly filled with brine through the bunghole, leaving slight space for expansion, and then bunged up. It should be stenciled or otherwise marked to show the nature and net weight of the contents. In very warm climates there is need for investigation of storage conditions under which salt fish can be kept successfully; until the subject is investigated, it is recommended that if fish are to be kept for any considerable time, they be placed in cool storage.

SUMMARY.—If the method is followed as herein described, river herring (and possibly other fishes) may be salted under surprisingly unfavorable conditions of temperature: the cured fish will be sweet and mild; they will soak out readily, and be free from the acrid salty taste characteristic of fish that have been cured in salt containing calcium and magnesium. They will be softer and less white or chalky in appearance than fish cured in crude salt, but these differences should be regarded as marks of superior quality.

Numerous recipes for cooking salt and smoked fish will be found in Economic Circular No. 29, "Why and How to Use Salt and Smoked Fish," published by the Bureau of Fisheries, and sent free on application.

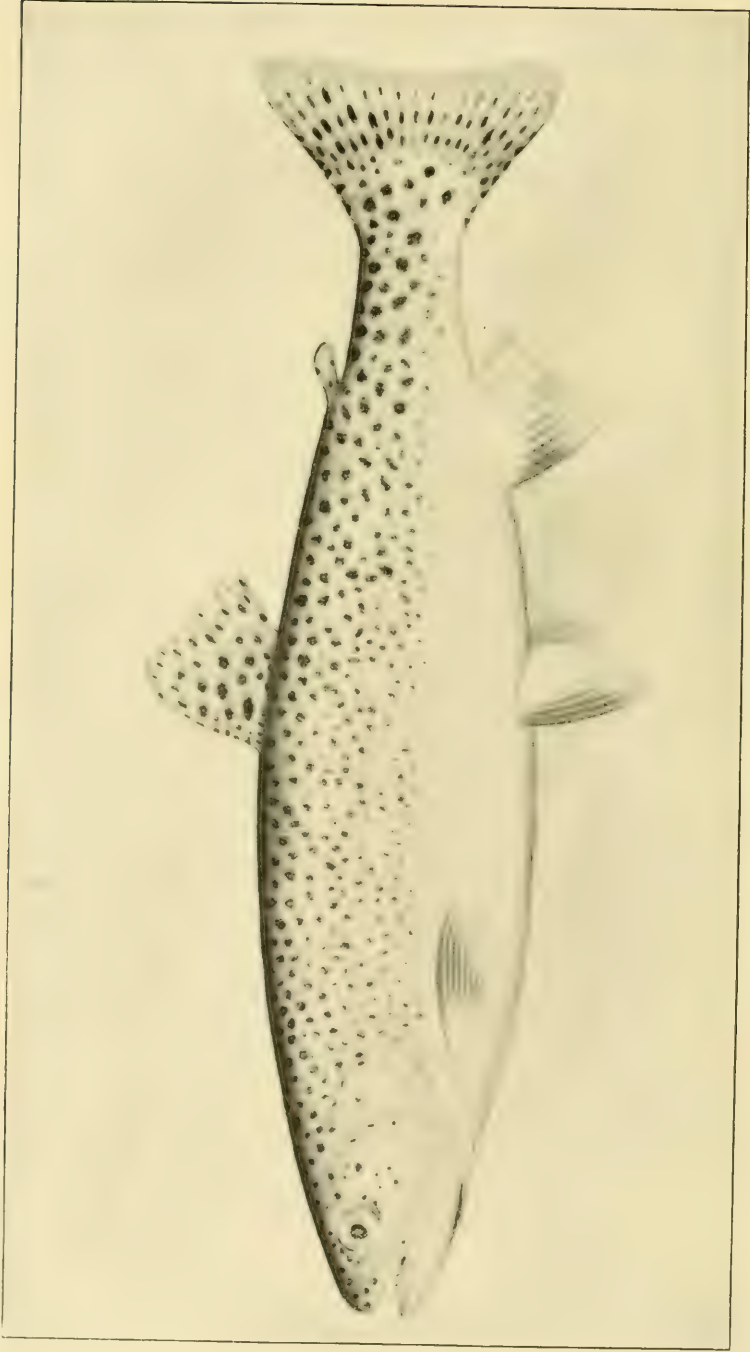


FIG. 3.—REDTHROAT TROUT; CUTTHROAT TROUT; BLACKSPOTTED TROUT.

FISHES OF THE YELLOWSTONE NATIONAL PARK.¹

With Description of the Park Waters and Notes on Fishing.

By HUGH M. SMITH and WILLIAM C. KENDALL.

CONTENTS.

| | Page. |
|--|-------|
| Introduction..... | 3 |
| Indigenous fishes..... | 4 |
| Introduced fishes..... | 5 |
| Fish culture in the park..... | 5 |
| Principal fishing waters..... | 7 |
| Fishing regulations..... | 16 |
| List of fishes..... | 16 |
| 1. Montana grayling..... | 16 |
| 2. Rocky Mountain whitefish..... | 17 |
| 3. Redthroat trout; cutthroat trout; blackspotted trout..... | 18 |
| 4. Rainbow trout..... | 21 |
| 5. Scotch lake trout; Loch Leven trout..... | 22 |
| 6. European brown trout; Von Behr trout..... | 23 |
| 7. Lake trout; Mackinaw trout..... | 24 |
| 8. Eastern brook trout; speckled trout..... | 26 |
| 9. Yellow perch..... | 27 |
| 10. Blob..... | 28 |
| 11. Longnose sucker..... | 28 |
| 12. Rosyside sucker..... | 29 |
| 13. Chub..... | 29 |
| 14. Silverside minnow..... | 30 |
| 15. Longnose dace..... | 30 |
| 16. Dusky dace..... | 30 |

INTRODUCTION.

The fishes of the Yellowstone National Park constitute one of the most interesting and noteworthy attractions of that wonderland. The special appeal which the fishes make to the park visitors comes partly from the beauty, gameness, and variety of the fishes, and partly from the inspiring environment in which fishing may be done. Among the wild, backboneed animals in the park the fishes are the only ones whose killing is allowed and encouraged by the park authorities. The greatly increased number of visitors to the park in recent years has brought the fishes into unusual prominence and necessitates renewed efforts to maintain the supply by means of artificial propagation and protection.

It is hoped that this little document relating to fishes and fishing may serve a useful purpose beyond merely furnishing information for anglers. Increased knowledge of the park fishes should have the effect of increasing the public appreciation of the extraordinary opportunity for healthful recreation that the park affords, and at

¹ Appendix III to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 904.

the same time should discourage unnecessary destruction of fish life and develop a spirit of cooperation with the Government agencies that are striving to maintain the fish supply.

The present report is a revised and amplified edition of the one published by the Bureau of Fisheries in 1915.² The exhaustion of the supply of that document and the continued public demand for information on this subject, together with the availability of new data on the fishes, make this publication desirable.

INDIGENOUS FISHES.

The native fish life of the park was profoundly affected by the great lava flow which occurred over a large part of the park in Pliocene times. Whatever fishes were then present were necessarily killed, and, with the reestablishment of the watercourses after the cooling of the surface of the lava, fishes in outside waters were to a great extent prevented from reaching the lofty plateau, which comprises most of the area of the park, by the high and steep falls over which the streams leave the lava beds.

It thus follows that the native fish fauna of the park is very limited. Except in Yellowstone River and its tributaries practically no fishes occur naturally above the falls, and in the extensive basin of that river the few species that do exist gained access to the region above the falls because of the imperfect watershed separating the Yellowstone and the Snake River basins.

The original comparative barrenness of the park in fish life was due entirely to topographical conditions. The physical character of the waters is, in general, highly favorable for fishes, and an examination of the streams and lakes of the park by Prof. Forbes in 1890³ disclosed the presence in certain barren waters of an abundant insect and crustacean food well suited for sustaining certain kinds of fishes. The theory that would account for the original absence of fishes in particular park waters as due to the high temperature and chemical constituents of the great volumes of water flowing from the geysers and hot springs is entirely untenable for several reasons: First, native trout abound and flourish in various streams and lakes in close proximity to the outpourings of geysers and hot springs, and, secondly, both native and exotic trouts have been successfully planted in barren waters receiving the discharge of geysers and hot springs.

The fishes of natural occurrence in the park represent 10 species, as follows: Longnose sucker, rosyside sucker, chub, silverside minnow, longnose dace, dusky dace, Rocky Mountain whitefish, red-throat trout, Montana grayling, and blob. Of these only the trout and the grayling have generally been recognized as game fishes, although the whitefish might properly be so considered. While these were very abundant in certain waters, the annually increasing numbers of angler-tourists in the park made it desirable to augment the natural supply of game fishes by the introduction into barren waters of selected species of other game fishes.

² The fishes of the Yellowstone National Park. By William C. Kendall. Bureau of Fisheries Document No. 818. 1915.

³ A preliminary report on the aquatic invertebrate fauna of the Yellowstone National Park, Wyo., and the Flathead region of Montana. By S. A. Forbes. Bulletin U. S. Fish Commission, vol. XI, for 1891, p. 207-258, pl. XXXVII-XLII. 1893.

INTRODUCED FISHES.

In immediate response to the outcome of investigations to determine the suitability of fishless park waters for game fishes, the Bureau of Fisheries in 1889 inaugurated the planting of selected species in predetermined waters, and this work has been continued to the present time. The one species of native trout was soon supplemented by the very successful introduction of five other trouts, and in a short time the park became an angler's paradise, affording better and more varied trout fishing than could be found anywhere else in the country, if not in the world.

The nonindigenous trouts that have been introduced into park waters are the rainbow, Loch Leven, brown, lake, and eastern brook trouts, all of which have become firmly established. The distribution of the native redbreast trout has been greatly extended into previously barren waters. The introduction of two other game fishes has been attempted, but apparently without positive results. One of these is the landlocked salmon (*Salmo sebago*), of which 7,000 fry were planted in Yellowstone Lake and 2,000 in Duck Lake in 1908, but not a vestige of these plants has ever been seen. The other species is the largemouth black bass (*Micropterus salmoides*), of which 500 fingerlings were planted in "lakes in Yellowstone National Park," according to the indefinite official record. These lakes are thought to have been Feather Lake and Goose Lake, in the Lower Geyser Basin. An earlier plant of 250 black bass was made in the Gibbon River, in 1893, but it is not known which of the two species of black bass composed this plant. There is no evidence of the survival of black bass anywhere in the park, and this may be regarded as a fortunate circumstance. In our opinion, there should be no further attempts to establish black bass in the park, as they do not harmonize with the trouts, and their predatory habits make them unsafe species to introduce among the soft-finned fishes which, with two minor exceptions, constitute the local fauna. The only other species of fish that has been introduced into park waters is the yellow perch, whose planting was unofficial and is apparently to be ascribed to the unauthorized act of a private individual. This fish now abounds in certain lakes in the Lower Geyser Basin.

FISH CULTURE IN THE PARK.

The hundreds of thousands of visitors who have already been in the park and the millions of others who are destined to visit it owe to fish culture and fish acclimatization a debt whose value can hardly be estimated. Within a few years after experienced fish-culturists began to give attention to needs of the park the hitherto fishless waters began to produce desirable game fish in abundance, and this has continued up to the present time. The early work, as well as the efforts of the fish-culturists of late, has been directed mostly to maintaining the supply of fishes already established.

For many years the Bureau of Fisheries has conducted fish-hatching operations in the park. The first hatchery was located at the Thumb of Yellowstone Lake; the principal hatchery now is on the lake shore near the Lake Hotel. In 1921 a permanent hatchery was erected on Soda Butte Creek, which had been the site of a field

hatchery for a number of years. The hatcheries are maintained, primarily, for the purpose of keeping up the supply of redthroat trout.

The redthroat trout is the only local trout which spawns during the season when the park is easily accessible and when it is possible without unwarranted effort and expense to obtain a supply of running water for hatching purposes. The adult fish begin to ascend the streams that are put into flood by the melting snows and they continue to run until the latter part of July. Some fish, however, doubtless spawn also in Yellowstone Lake and other large lakes.

The principal supply of eggs for hatching purposes comes from creeks on the eastern side of Yellowstone Lake. Into these creeks the trout run at spawning time and across them the fish-culturists erect intercepting barricades or racks. These racks are provided with narrow passageways that lead into traps in which the fish congregate. The trout are transferred to live cars, where they are held pending the ripening of their eggs. At the proper time the eggs are stripped from the fish and held at improvised field hatcheries pending shipment to the central station. The adult fish are released alive.

The questions naturally arise, Why not let the trout run up the creeks and spawn naturally? Why not permit the eggs to hatch in the manner intended by nature and let the young remain for awhile in the water where they were born and then run back to the lake at the proper time? These questions, which will, no doubt, be asked by many thoughtful park visitors, afford an opportunity to indicate one way in which it is possible to improve on nature and to point out why in the Yellowstone National Park, as elsewhere, it is desirable or necessary for the fish-culturist to go to nature's assistance.

The streams in which the redthroat trout spawn are usually much swollen at the time of the run. Pushing upstream energetically, the fish often go far from the lake and deposit their spawn during high water in places which later, with the complete melting of the snow, may become exposed to the air. Heavy losses of eggs occur in this way. If conditions are favorable for the laying and hatching of the eggs in streams that may be raging torrents in spring and early summer, it frequently happens that by July and August such streams become almost dry, are cut off from the lake and reduced to disconnected pools, and the young fish necessarily perish sooner or later.

The adverse conditions occurring in nature make it probable that at best only 5 or 10 per cent of the eggs produce fry that reach the feeding stage at which the hatchery turns the fish loose. On the other hand, fully 90 per cent of the eggs taken by artificial methods are safely incubated and yield fry that are liberated in selected places—along the lake shore or near the mouths of open creeks where there is a good prospect of survival.

There are still a few fishless waters in the park, but each season additional lakes and streams are stocked and ultimately all waters suitable for fish will have received attention. In 1919 Mallard Lake, a beautiful mountain gem not far from Old Faithful Inn, was found to be fishless and was planted with eastern brook trout. This seems destined to become a favorite angler's resort. Other waters

recently stocked with redthroat trout for the first time are various lakes in the southwest section of the park.

PRINCIPAL FISHING WATERS.

The fishing season in the park does not ordinarily begin before July, by which time, according to one of the angling writers hereafter cited, "the plethora of water has disappeared and the streams flow swift, clear, and cold. At this season of the year trout fishing is at its best."

Information regarding the fishing in various localities may be found in the annual reports of the superintendent of the park, particularly the report for 1897, and in the annual circulars of information issued by the National Park Service. The following publications pertaining wholly or partly to fishing in the park may be consulted for detailed or special data:

Fish in the National Park and tributaries of Snake River. By J. E. Curtis. Bulletin U. S. Fish Commission, vol. iv, for 1884, p. 335-336.

A reconnaissance of the streams and lakes of the Yellowstone National Park, Wyo., in the interest of the United States Fish Commission. By David Starr Jordan. Bulletin U. S. Fish Commission, vol. ix, for 1899, p. 41-63, with map and many plates.

A reconnaissance of the streams and lakes of western Montana and northwestern Wyoming. By Barton W. Evermann. Bulletin U. S. Fish Commission, vol. xi, for 1891, p. 3-60, with plates and maps.

A woman's trout fishing in Yellowstone Park. By Mary Trowbridge Townsend. Outing, vol. xxx, no. 2, May, 1897, p. 163-164.

A list of the fishes of Montana, with notes on the game fishes. By James A. Henshall. Bulletin of the University of Montana, No. 34, Biological series no. 11. 1906.

Wyoming summer fishing and the Yellowstone Park. By Ralph E. Clark. Outing, vol. lvi, no. 4, July, 1908, p. 508-511.

Fly fishing in wonderland. By Klahowya (O. P. Barnes). 56 p. 1910.

The Yellowstone National Park. By Hiram Martin Chittenden. Fishes, p. 210-212. 1915.

The following annotated list of park fishing waters is based partly on information kindly furnished by Col. L. M. Brett, United States Army, formerly acting superintendent of the park; partly on notes taken from the works before cited; partly on observations by A. H. Dinsmore, of the Bureau of Fisheries, in 1919 and 1920; and partly on the senior author's observations in 1914 and 1919.

YELLOWSTONE LAKE.

Yellowstone Lake is one of the most beautiful lakes in the world. It and some of the tributary creeks abound with the native or redthroat trout. There appear to be no other game species in the lake. Landlocked salmon planted in 1908 and 1909 have not been seen since. The rainbow trout, planted at the same time in some of the affluents, have shown no evidence of establishment, excepting on the statement of Mr. Croley, a hotel fisherman for 12 years, to the effect that he had seen only one fish other than the blackspotted trout. This fish "looked different and had a broad side band" and was thought to be a rainbow.

In 1919 the senior author found the water of Flat Mountain Arm, though shallow, distinctly colder than in the lake, evidently owing to the inflow of springs and the creek at its head. Near the head of

this arm he found the largest redthroat trout met with in the park, fine, clean, trim, vigorous fellows, not like those observed elsewhere.

All suitable tributary creeks contain redthroat trout. The most notable creeks on the east side of the lake, enumerated from north to south, are: Pelican, Cub, Clear, Columbine, and Beaverdam Creeks. All contain native trout. Sylvan Lake, which discharges through Clear Creek in times of high water, contains a few trout. It is a beautiful mountain lake, clear and moderately cold. Ralph E. Clark said of Pelican Creek:

One mile east of Yellowstone River outlet is Pelican stream, which rises in the cold snows of the mountains and empties its waters into the lake. Here you catch quantities of uncontaminated trout, large, beautiful, fat, and gamy, as free from worms as the fresh cold waters they swim in are free from pollution.

On the west side of the lake, named in the same order, are Bridge Creek, entering Bridge Bay; Arnica Creek, an affluent of the north-west side of the Thumb; Solution Creek, a small, narrow stream, with lava bottom and grassy banks bordered with willows, the outlet of Riddle Lake, sometimes going dry. Riddle Lake, so called because of the former mystery of its outlet, is a clear pond of roundish outline, about $1\frac{1}{2}$ miles in diameter, about whose outlet are numerous lily pads and other plants. Its shores are shallow, and its bottom is chiefly of lava gravel. The temperature is about 50° F. Trout are numerous.

Near West Thumb is another small, deep-set lake, named Duck Lake, which has no outlet. It formerly contained no trout, but redthroat trout and landlocked salmon were planted in it. Redthroat trout now appear to be abundant, but landlocked salmon have never been observed. However, the senior author found good-sized Loch Leven trout common in 1919.

Grouse and Chipmunk Creeks enter opposite sides of the southern end of the South Arm. Besides these there are numerous unnamed creeks, some of which go dry in summer. One, however, flowing into Flat Mountain Arm, was found by the senior author on July 17, 1919, to contain more water than many of the other creeks around the lake, probably never going dry. A creek that will flow as did this one during a period of drought, with the lake level one-third lower than ever before known, must be permanent. The creek, unnamed on the available maps, clear and cold, with beautiful green, grassy banks with trees here and there, meanders to an extraordinary degree through a broad, open valley, flowing over a gravelly bed, now with riffles, now with deep holes, making a charming trout brook. At its mouth is a flat much frequented by elk. This creek was found to contain numerous trout of season's hatch; some 3 to 5 inches long of the previous season; and older fish up to 12 inches in length.

YELLOWSTONE RIVER ABOVE THE LAKE.

Above the lake the Yellowstone River winds through marshy meadows, between wooded hills, behind which are the rugged peaks of high volcanic mountains. The current is sluggish, and, according to Mr. Dinsmore, the fall is so slight that it would be a comparatively easy matter in times of ordinary flow to travel by canoe the entire distance from the lake to the southern boundary of the park.

The principal tributaries of this portion of the river from the lake southward on the left are Cabin, Trappers, Mountain, Cliff, Escarpment, and Thoroughfare Creeks. On the other side in the same direction are Badger, Phlox, and Lynx Creeks. Good fishing is found in the river and in the creeks high up where they meander from the mountains.

YELLOWSTONE RIVER BELOW THE LAKE.

Below the lake to the upper falls there is no great descent, and the river flows for about 15 miles with a quiet current. Here its banks are bordered with low hills, some of them wooded, others forming open pastures. On the right side going northward the principal creeks are Cotton Grass and Sour Creeks, which unite to discharge their waters into the Yellowstone not far from Alum Creek on the opposite side of the river. On the west side of the river is Trout Creek, which is a clear stream, with grassy banks and gravelly bottom. It has a summer temperature of about 58° F. and is a good trout stream.

Alum Creek is a clear stream about 8 feet wide and 1 or 2 feet deep, rising in the Continental Divide opposite the head of Nez Perce Creek and flowing eastward through the grassy fields of Hayden Valley. Its bed contains much white alkali from the hot springs above, and there is a perceptible alkaline taste to the water, which has a temperature of about 60° F. in summer. In its upper course it has some hot tributaries. One of these is Violet Creek, with a number of hot springs and mudholes. Still another fork is charged with alum, but a third branch is said to be one of the best redthroat trout streams in the park.

YELLOWSTONE RIVER AND BRANCHES BELOW THE FALLS.

About 15 miles below the lake the river plunges into a deep canyon over two vertical falls 109 feet and 308 feet in height. This remarkable canyon is more than 20 miles long, with nearly perpendicular walls 800 to 1,100 feet in height. The current below the falls is swift until the river leaves the park.

The most important eastern tributary of the Yellowstone River is Lamar River. It is a large stream, sometimes referred to as the East Fork of the Yellowstone. It joins the Yellowstone not far below Butte Junction. There are many tributary creeks of various sizes, particularly on the north and northeast side. The principal of these are: Miller, Calfee, Cache, Soda Butte, joined by Amphitheater and Pebble Creeks; Slough Creek, the largest branch of which is Buffalo Creek. On the west side the creeks are smaller than most of those of the other side, the principal ones being Cold, Willow, and Timothy, near the upper course. Chalcedony Creek is farther down, and all but Cold Creek are in rather deep ravines near the river. Cascade Creek is a clear brook a few feet wide which enters the Yellowstone between the falls. The high, nearly vertical "Crystal Falls" (129 feet) is near the mouth of the stream and, of course, prevents the ascent of fishes. Redthroat trout were once planted above the falls.

Lamar River and most of its tributaries are inhabited by native trout. The junction of Yellowstone and Lamar Rivers is noted for fine fishing. Soda Butte is well stocked up to near its head, where a waterfall keeps the fish back. According to Mr. Dinsmore, Fish Lake, where the Bureau of Fisheries has for a number of years collected native trout eggs and where in 1921 a small hatchery was established, is a very remarkable water, with an area of only 75 acres. It contains a dense growth of vegetation, which in the late summer blossoms near the surface. After sundown the fish, which average about 2 pounds each, will come up out of the weeds and take gray-hackle flies almost as fast as they can be placed upon the water.

Slough Creek is said to be well stocked with trout up to the lakes at its head, only one of which, Lake Abundance, in Montana, contains trout.

Hellroaring Creek, which joins the Yellowstone from the north below the mouth of Lamar River, is abundantly supplied with native trout in its lower part.

The tributaries of the west side of the Yellowstone worthy of mention all enter this river below the Grand Canyon. The uppermost is Antelope Creek, which joins the river not far from the mouth of Tower Creek. It contains native trout. Tower Creek, for almost its whole length, is hidden in dense forests. Its current is swift, and it is perhaps the coldest stream in the park, the summer temperature being about 45° F. Carnelian Creek is one of its upper branches. About one-fourth mile from its mouth the creek forms a singularly picturesque, quite vertical fall of 132 feet, which is surrounded by lofty towers of volcanic conglomerate. Below the falls is a deep canyon, where the stream is about 10 feet wide and shallow. The waters above the falls were barren previous to the introduction of eastern brook, rainbow, and redthroat trouts.

The lower tributaries of the Yellowstone in the park are Geode Creek, Blacktail Deer Creek, and Gardiner River. Geode Creek is small. Rainbow trout planted in it in 1909 have not since been observed. Blacktail Deer Creek is a clear, rather cold (55° F.) stream running largely through open pastures, with willows along its course. It has no canyons or falls. Its bottom is of laval gravel and rocks, with some water weeds. In summer it is usually 5 or 6 feet wide by 1 or 2 feet deep and is well stocked with native redthroat trout and rainbow trout. Eastern brook trout were planted in 1912, 1913, and 1914.

GARDINER RIVER AND ITS BRANCHES.

In the park Gardiner River may be said to be formed by two branches, designated on the maps as Lava Creek and Gardiner River, but the latter is sometimes referred to as the "Middle Fork."

Lava Creek is a clear, mountain stream in its upper course, flowing through evergreen forests on the north side of the mountain range. The stream is normally about 10 feet wide and 1 or 2 feet deep. Toward its mouth it cuts its way into a broad, flat shelf of lava, forming two falls about one-tenth of a mile apart. The upper falls, called Undine Falls, are vertical for about 30 feet, with two additional leaps of about 20 and 10 feet. The lower falls are vertical and about 50

feet high. Below these falls the stream flows through a highly picturesque canyon, joining Gardiner River above Mammoth Hot Springs.

Lupine Creek is a small tributary of Lava Creek, entering it above the falls. Near its junction with Lava Creek this creek has a cascade about 100 feet high called Wraith Falls. Notwithstanding the barrier offered by the falls, Dr. Jordan said that it was reported on good authority that small trout had been taken in Lava Creek above the falls. His attention was called to a possible means of access from Blacktail Deer Creek to Lava Creek in times of high water. In Lava and Lupine Creeks the only trout is the native redthroat. Below the falls native redthroat and Loch Leven trouts occur in Lava Creek.

Gardiner River, or Middle Fork, rises on the east slope of the Gallatin Mountains in the northwestern part of the park. It flows eastward, southward, then abruptly northward, bending around Bunsen Peak and forming a deep canyon, toward the head of which are Osprey Falls. Gardiner Canyon is some 800 to 1,000 feet deep, with vertical walls of lava, basalt, etc., and in grandeur is surpassed only by the Grand Canyon of the Yellowstone. Osprey Falls are about 150 feet high and nearly vertical. The principal headwaters of the Gardiner are Fawn, Panther, and Indian Creeks, which, with their branches, unite near Seven-mile Bridge. Winter and Straight Creeks unite into one stream and join Obsidian Creek to form Willow Park Creek, which also joins the Middle Fork near Seven-mile Bridge. Obsidian Creek originates in or near Twin Lakes, according to Jordan, and some of its branches in other small lakes, notably Lake of the Woods, which flows into Beaver Lake. At first the creek is very small, and its course for 2 or 3 miles is full of hot springs, solfataras, boiling mudholes, and various similar heated areas. Lower down cold springs enter the stream, and at Beaver Lake the water is clear and cold. Beaver Lake is a shallow, grassy pond, about a mile long, formed in the stream by the beavers. Eastern brook trout are reported as plentiful, but the rainbow trout, also planted there, have never been heard of. Below this lake the creek receives the clear, cold waters of Winter Creek and Straight Creek.

Winter Creek is a large stream which heads in Christmas Tree Park at the foot of Mount Holmes. Straight Creek flows through dense woods, open grass-grown meadows, and narrow canyons. It is a very pretty stream, with many riffles and deep holes behind prostrate logs, and wide, shallow, gravelly reaches. In the course of Straight Creek is Grizzly Lake. It is a gem, with steep, wooded banks, clear, cold water, with shelving bottom and quite deep center. After their junction the waters of these creeks, under the name of Willow Park Creek, flow through Willow Park, a large mountain meadow, at the foot of which it meets the waters of Indian Creek and the others which have been mentioned, forming the Middle Fork of Gardiner River. Indian Creek is a clear, cold stream similar to the Gardiner.

All of the aforementioned creeks, previously barren, now teem with eastern brook trout, the only trout occurring in them. Jordan reported that Obsidian Creek with Winter Creek was one of the best eastern brook trout streams in the park. Its summer temperature is about 50° F. Its bottom is composed of laval gravel, lined with

grass, algae, and other water plants in which small crustaceans abound. The senior author observed that Straight Creek teemed with brook trout of all sizes up to 12 inches long. Hundreds, mostly about 6 or 7 inches long, were observed. The fish were the most beautifully colored seen in the park. Males only 3 or 4 inches long showed the brilliant coloration of the fully developed fish in breeding season. Females 6 inches in length and upward had well-developed eggs. Grizzly Lake contains very large brook trout.

Above Osprey Falls the Gardiner is a clear, cold stream, having a temperature of about 50° F. The bottom is composed of numerous stones and bowlders, and there are many deep holes. This previously barren stretch of water now contains the introduced eastern brook, Loch Leven, brown, and rainbow trouts. About halfway down from the falls to the junction with the East Fork Glen Creek joins the river on the left side. Glen Creek has been called the West Fork of the Gardiner. It rises in the Sepulcher Mountain region and flows southeast to Swan Lake outlet, thence northeast, joining the Gardiner at the foot of the canyon. It is a small stream, only 5 or 6 feet wide and 1 or 2 deep, which runs mostly through open meadows, with gravelly and grassy bottom. Its waters are very cold, about 48° F. in summer. Glen Creek has a waterfall some 70 feet high, known as Rustic Falls, at the Golden Gate near the base of Bunsen Peak. A small lake in the vicinity of Sepulcher Mountain was stocked with eastern brook trout in 1912, but the results are as yet uncertain. Below the falls the deep canyon is so choked with bowlders and talus that fish can not ascend it.

Swan Lake is a small, roundish pond about a half mile long, with a bottom of crumbled lava. While the water near shore is very shallow, the depth at the center seems considerable. The water is clear and cold and abounds with insects and crustaceans.

Eastern brook trout abound in the creek above the falls, but those planted in Swan Lake, it is said, seem to have left the lake for the small streams, as they have not been found in the lake. Near the junction of the Gardiner with the East Branch the stream is rough and boulder-strewn, but of a good volume, much like the Gibbon in character. The lower course of the Gardiner below the falls is well stocked with native redthroat trout and introduced eastern, rainbow, and Loch Leven trouts. Indigenous whitefish, suckers, and minnows also occur.

Below Mammoth Hot Springs the scalding waters of those springs discharge through "Hot River" into the Gardiner. It is said that in winter native trout are especially abundant at the mouth of the stream.

GIBBON RIVER ABOVE FALLS, GREBE AND RAINBOW LAKES.

Gibbon River issues from Grebe Lake, which is located in a marshy area in the highlands. Grebe Lake is about a mile long and is one of the most attractive small lakes in the park. It was stocked with redthroat trout in 1912, but the results are not definitely known.

Approximately a mile or a mile and a half below Grebe Lake is another small lake visited by the senior author and Mr. Dinsmore in 1919. They proposed to name it Rainbow Lake. The lake drains a very extensive marshy area whose arms extend far into the hills, with greatly meandering, clear, cold streams. The lake has a gravelly

bottom, gently sloping shores, and a deep center. At several points are extensive beds of yellow water lilies, and the mouth of the large main affluent is covered by the same plants. Large rainbows frequent the lake and the effluent, and smaller fish abound in all the minor streams.

Gibbon River emerges from the southeast corner of Rainbow Lake. About a mile below the lake are hot mineral springs which discharge into the river, and for a mile or more the water is warm, distinctly impregnated, and fishless. Then cold springs entering the river from the hillsides render the stream again inhabitable by trout, which occur all the way to the Upper Falls of the Gibbon. These falls are too high to permit of the passage of fish upward.

From Virginia Cascade to Norris Station the river, with Solfatar Creek, affords fine fishing for eastern brook trout. Mr. Dinsmore reports that on July 26, 1919, he had wonderful fishing for this species and no other species was observed in this section of the river, although rainbows occur above Virginia Cascade and in the Gibbon below Norris Station.

Below the falls Canyon Creek, entering the river from the eastward, contains redthroat trout. From the falls to the junction of the Gibbon with the Madison the fish are the same as those occurring in the Madison and below the cascades of the Firehole.

MADISON RIVER AND ITS BRANCHES, FIREHOLE RIVER, NEZ PERCE CREEK, LITTLE FIREHOLE RIVER, ETC.

Native redthroat trout, whitefish, and grayling are abundant, as are also the introduced Loch Leven and brown trouts in the upper Madison.

The Firehole River, about twice the size of the Gibbon River, joins it from the south. This stream heads just west of Shoshone Lake, separated from it and from the head of Bechler River by a relatively low divide, according to Gannett. It flows through Madison Lake, which is nearly dry in summer, but below it is reinforced by the fine, clear Spring Creek from the east. In its upper course the Firehole, like Spring Creek, is a clear and very cold stream, flowing through dense woods, with narrow marshy valleys alternating with small canyons. Keppler's Cascades, above the Upper Geyser Basin, is a series of very picturesque falls probably impassable to trout. Along the Firehole are the most noteworthy of the geyser basins, and a great volume of hot water is poured into it without, however, rendering its waters at any point really warm or unfit for trout. The principal tributaries are Iron Creek and Little Firehole River, in the Upper Geyser Basin. At the lower basin the Firehole receives the waters of Sentinel Creek, Fairy Creek, and the larger and more important Nez Perce Creek.

Nez Perce Creek comes in from the east, is nearly half as large as the Firehole, and is similar in character and temperature of the water. It is fed by numerous short streams, none of them hot and most of them confined to a narrow canyon.

Madison River.—The name Madison is used only for the river below the junction of its chief tributaries, the Firehole and Gibbon Rivers. The principal tributaries of the Madison as thus defined join the river

beyond the park boundary. Named in order from the south to north they are Cougar, Gneiss, and Grayling Creeks. Within the park Cougar Creek receives the waters of Maple Creek, the principal tributary of which is Duck Creek. These upper waters are inhabited by native redthroat trout. Campanula Creek joins Gneiss Creek beyond the park boundary. It also contains redthroat trout, as do the upper waters of all three of the main creeks mentioned, and in their lower courses they have whitefish and grayling besides native trout. The main Madison appears to contain a mixture of all the trouts that occur in the park, as well as whitefish and grayling.

SNAKE RIVER DRAINAGE.

Above its junction with Heart River the Snake pursues a northwest course, receiving numerous small tributaries, the most important of which is, perhaps, a branch which heads in Mariposa Lake. Two relatively large tributaries come in from the northeastward—Crooked and Sickie Creeks.

Mariposa Lake is a small body of water in the southeast corner of the park about a mile north of the park boundary. It is said to be alive with native redthroat trout and to afford wonderful fishing for large trout. About a mile beyond the boundary Bridger Lake is another remarkable native trout water.

Heart Lake, about $3\frac{1}{2}$ miles long and not quite 2 miles in width, lies in a deep depression at the eastern foot of Mount Sheridan. Near the head of the lake and in the lake are numerous geysers and hot springs. Its bottom is of laval gravel, rather shallow near the shore but becoming deep in the middle. It receives some small tributaries, principal of which are Witch and Beaver Creeks. Heart River, its outlet, just below the lake receives a comparatively large tributary known as Surprise Creek.

Witch Creek has its rise 2 or 3 miles above the lake, in the singular collection of geysers, hot springs, and steam holes known as Factory Hill. Its water is at first scalding hot, but it gradually cools, receiving the waters of one cold tributary as large as itself. The lower course of Witch Creek winds through grassy meadows, with a bottom of fine laval gravel and sand. The creek at its mouth has a temperature of about 75° F. Native redthroat trout are numerous, occurring most commonly about the mouth of the creek. Besides the trout are suckers, chubs, and shiners, and the blob, or fresh-water sculpin, also occurs. There is plenty of fish food in the lake. The temperature varies according to the nearness to hot springs and geysers. Trout are said not to ascend Witch Creek, although the other species do, the chubs ascending until the water is fairly to be called hot.

Beyond the mouth of Heart River the Snake bends to the southward, thence later to the westward, receiving a number of tributaries, the largest being Basin Creek, Red Creek, and Forest Creek from the north. All the tributaries flowing directly into the Snake contain native redthroat trout.

Lewis River, which joins the Snake just within the park boundary, is the outlet for the waters of Shoshone and Lewis Lakes.

SHOSHONE LAKE AND TRIBUTARIES.

This lake has a length of about $6\frac{1}{2}$ miles and a width of one-half to $4\frac{1}{2}$ miles, being dumb-bell shaped or constricted in the middle. Its area is about 12 square miles. Its shores are mostly bold, rocky, and densely wooded, the eastern shore being especially abrupt, and the bottom is there made by large lava boulders. On the other side somewhat different conditions obtain, there being a considerable growth of aquatic vegetation. The lake is clearer and colder than either Yellowstone Lake or Heart Lake. The principal tributaries are Shoshone Creek at the northwest corner and De Lacy Creek at the northeast corner. Moose Creek from the southward enters the southern side of the eastern expansion of the lake. Shoshone Lake is connected with Lewis Lake at the southward by a stream of still water known as the "Canal," about 3 miles long.

Lewis Lake occupies a rounded basin with rather low banks. It is pear-shaped, about 3 miles long by 2 miles broad, very clear and cold, and apparently in every way suited for trout. Its bold shores are heavily wooded and without any large tributary streams. A few hot springs enter it on the western side.

Below Lewis Lake Lewis River enters a deep and narrow canyon. At the head of this canyon is a cascade of about 80 feet, of which 20 feet at the top is perpendicular. Toward the end of the canyon and not far above the junction with the Snake is another cascade some 50 feet in height. Owing to the falls in Lewis River no fish were able to ascend to Lewis and Shoshone Lakes, which were therefore uninhabited by any trouts until they were introduced.

Loch Leven and lake trouts are numerous, and eastern brook trout abound in Shoshone Creek. Mr. Clark wrote that the Shoshone and Lewis Lake region was probably the best fishing in the park:

These two lakes and their outlet, Lewis River, are full of native trout and have been stocked with Mackinaw and Loch Leven trout, which are increasing in number and size most successfully. These fish will not rise to the surface and take the fly as do the regular native trout, and it is necessary to go down into the water for them. In the lakes you can catch them by trolling if you can find the particular cove where they happen to be running. However, in spite of the uncertainty of the lake trolling, there is one place where you can troll with assurance of success, and that is the canal between Shoshone and Lewis Lakes. This is a natural body of water with little or no current and not very wide. In Lewis River just below Lewis Falls, in the deep pools where the eddies are covered with foam, you are sure to find good fishing.

Rainbow trout said to have been planted in De Lacy Creek in 1895 have never been observed, but eastern brook trout of small size are numerous.

FALLS RIVER AND BECHLER RIVER.

Falls River pursues a sinuous course near the boundary in the southwestern corner of the park. It rises by two branches, one originating in a marshy area, the other in Beula Lake, near which are Herring Lake and another smaller one, both mere ponds, and flows to the eastward. In the Birch Hills it passes through a short ravine, flowing over two falls, Terraced and Rainbow Falls, the latter being the most westerly. Before joining Bechler River it receives a considerable creek, Mountain Ash by name, which flows down from the south side of Pitchstone Plateau.

Bechler River rises on the northwest side of Pitchstone Plateau and winds to the southward to its junction with Falls River just north of the boundary. It passes through a deep gorge in which are several falls, notably Iris Falls, and a short distance below Colonnade Falls. Below these falls it receives several tributaries, the most important of which is Boundary Creek, which rises across the border and flows southeastward to its junction with Bechler River.

In 1920 A. H. Dinsmore visited this region and reported it as one of the most beautiful, if not the most beautiful, of the valleys in all the park—flat as a floor, abounding in wild and domesticated grasses, meandered by fine, clear streams in which native trout of good size may be taken in large numbers. At the head of the valley, within an area of not more than 3 miles, not less than eight streams fall from the timbered plateau over falls and cascades which rival any in the park excepting the Great Falls of the Yellowstone. So close to the valley are these waterfalls that many of them are in plain view as one rides through it.

Native trout are abundant in Falls River, probably up as far as Rainbow Falls, and in Mountain Ash Creek to Union Falls; also in all the waters below the falls.

FISHING REGULATIONS.

In order to prevent undue destruction of fish and depletion of the park waters, certain restrictions have become necessary, and it is believed that anglers generally will be in full sympathy with the protective measures that the park authorities find it desirable to adopt from time to time. The general policy is to curtail fishing as little as may be compatible with the maintenance of the supply and to depend largely on increased fish-cultural operations to prevent the depletion of park waters.

Following are the fishing regulations now in force:

1. Fishing with nets, seines, traps, or by the use of drugs or explosives, or in any other way than with hook and lines, or for merchandise or profit, is prohibited.
2. Fishing in particular waters may be suspended by the superintendent.
3. All fish hooked less than 8 inches long shall be carefully handled with moist hands and returned at once to the water, if not seriously injured. Fish retained should be killed.
4. Ten fish shall constitute the limit for a day's catch per person from all waters within 2 miles of the main belt-line road system. In the case of other waters the superintendent of the park may authorize a limit of not exceeding 20 fish for a day's catch per person.

LIST OF FISHES.

1. MONTANA GRAYLING (*Thymallus montanus*).

The Montana grayling, which originally existed only in tributaries of the Missouri River above Great Falls, in the park occurs naturally in the Madison and Gallatin Rivers and their branches, Grayling Creek and Fan Creek, and in the Firehole River below the falls. It is reported as sometimes abundant at the junction of the Gibbon and Firehole Rivers and is said to ascend in summer as far as Firehole Falls. It is the principal fish in the south fork of the Madison and occurs also in the backwater of the Madison at the dam. This is a most graceful and attractive fish, of shapely proportions and ex-

quisite coloration. The adult averages about 1 pound, but may attain a weight of 4 pounds.

The grayling prefers swift, clear, pure streams, with gravelly or sandy bottom. It is quite gregarious, lying in schools in the deeper pools, in plain sight, and not, like the trout, concealed under bushes and overhanging banks. In search of food, which consists principally of insects and their larvæ, it occasionally extends its range to streams strewn with boulders and broken rocks.

Unlike the native trout, the grayling will go long distances, if necessary, to find suitable spawning grounds. It spawns in April and May on gravelly shallows. In the north fork of the Madison River, where the water is comparatively warm, coming from the Firehole River in the park, the grayling spawns a month earlier than in any other waters in Montana.

In point of activity it even excels the native trout, when hooked breaking the water repeatedly in its effort to escape, which the trout seldom does. It takes the artificial fly eagerly, and if missed at the first cast will rise again and again from the depths of the pool, whereas

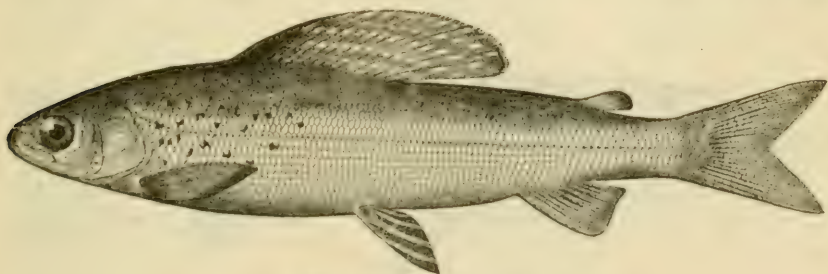


FIG. 1.—Montana grayling.

the trout will seldom rise a second time without a rest. It will also take various baits, such as caddis-fly larvæ, grasshoppers, and worms. Among the recommended flies are professor, Lord Baltimore, queen of the water, grizzly king, Henshall, coachman, and various gauze-winged flies, with No. 10 and 12 hooks. As a food fish it is even better than the trout, its flesh being firm and flaky, very white, and of delicate flavor. The grayling is artificially propagated in Montana by the United States Bureau of Fisheries and the State fish commission.

2. ROCKY MOUNTAIN WHITEFISH (*Coregonus williamsoni*).

The Rocky Mountain whitefish occurs in all suitable waters on the west slope of the Rockies from Utah to British Columbia. A scarcely, if at all, distinguishable variety or subspecies bearing the name of *Coregonus williamsoni cismontanus* is found in certain waters of the upper Missouri Basin. In some localities this fish is miscalled grayling,¹ with which it should not be confused, as it is a very different species, and there seems to be a local Yellowstone River name, the phonetic spelling of which is "sterlet" or "steret."

¹ Referring to the fishing in the canyon of Sunlight Creek, Clark Fork, Ralph E. Clark probably made this mistake in writing the following: "You will probably first catch a scaly fish which looks like a long sucker. It is the Montana grayling, and there are many down there."

In the park it naturally occurs in the Yellowstone River below the falls as far up as Crevice Gulch, beyond which it is seldom found, in Madison and Gallatin Rivers below the falls, and has been reported also from the junction of Firehole and Gibbon Rivers. At the junction of Lewis and Snake Rivers "grayling," or "mountain herring," are reported as taken by anglers; these are doubtless whitefish.

Young whitefish 2 to 5 inches long from Montana were planted in park waters, as follows: In 1889, 2,000 were placed in Twin Lakes and 980 in Yellowstone River above the falls, and 10,000 more were planted in the latter place in 1890. It is considered doubtful if any of these have survived, owing to the number and size of voracious trout in the Yellowstone River and the mineral character and high temperature of Twin Lakes.

This fish prefers clear, cold lakes and streams, where the usual length of adults is about a foot, although it is known to have attained a weight of 4 pounds. The *cismontanus* form is essentially a river fish rather than an inhabitant of lakes and is most abundant in the

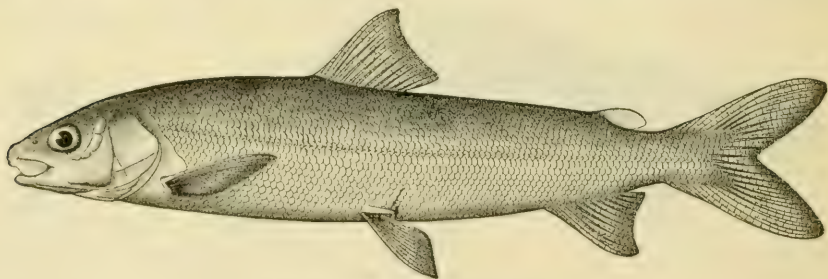


FIG. 2.—Rocky Mountain whitefish.

eddies or deeper places of swift streams. It spawns in late fall or early winter. This is a slender, graceful fish, readily taking the artificial fly like a grayling or trout, as well as natural baits, such as worms and insects and even fresh meat. However, owing to the smallness of its mouth, the hook should be no larger than No. 10 or 12, and when hooked the fish requires careful "playing" owing to the tenderness of the mouth parts. It is a game fighter. It ranks high as a panfish, for, when in condition, it is of surpassing sweetness and delicacy of flavor.

3. REDTHROAT TROUT; CUTTHROAT TROUT; BLACKSPOTTED TROUT (*Salmo lewisi*).

(See frontispiece.)

In its numerous varietal, subspecific, or specific forms the redthroat, cutthroat, or blackspotted trout is of extensive distribution on the Pacific slope. In the park a form designated as *Salmo lewisi* is found naturally in both upper Snake and upper Missouri waters, having doubtless gained access to the latter from the Snake River by the way of Two Ocean Pass, and it is not unlikely that an interchange of individuals still takes place.

Yellowstone Lake and Yellowstone River from its source to many miles beyond the park are inhabited by it. The abundance of trout above the falls is remarkable. At almost any time as one passes along fish are seen breaking water.

Trout are known to naturally occur in the following park waters:

Lower Yellowstone River.

Sour Creek.
Trout Creek.
Alum Creek.
Antelope Creek.
Lamar River.
Cold Creek.
Willow Creek.
Timothy Creek.
Miller Creek.
Calfee Creek.
Cache Creek.
Soda Butte, Pebble, and Amphitheater Creeks.
Slough and Buffalo Creeks, Lake Abundance, etc.

Hellroaring Creek.

Blacktail Deer Creek.

Gardiner River.

Lava and Lupine Creeks.

Yellowstone Lake.

Beaverdam Creek.
Rocky Creek.
Trail Creek.
Chipmunk Creek.
Riddle Lake and Solution Creek.
Arnica Creek and Beach Lake.
Columbine Creek.
Clear Creek.
Bear Creek.
Pelican Creek.

Upper Yellowstone River.

Atlantic Creek.
Jay Creek.

Upper Yellowstone River—Continued.

Bridger Lake and Creek.
Falcon Creek.
Thoroughfare Creek.
Escarpment Creek.
Cliff Creek.
Lynx Creek.
Phlox Creek.
Mountain Creek.
Badger Creek.
Trappers Creek.
Madison River.
Canyon Creek.
Cougar Creek.
Maple Creek.
Gneiss Creek.
Snake River.
Fox Creek.
Crooked Creek.
Sickle Creek.
Pacific Creek.
Heart Lake and Heart River.
Witch Creek.
Beaver Creek.
Surprise Creek.
Basin Creek.
Colter, Harebell, and Wolverine Creeks.
Red Creek.
Forest Creek.
Falls River.
Mountain Ash Creek.
Bechler River and tributaries to the canyon.
Boundary Creek to the falls.

Gibbon River has no trout above the falls. In the Firehole River trout occur naturally below the falls. At times near the junction with the Madison there is very good fishing.

In the Gardiner River trout are abundant from the foot of the falls to its junction with the Yellowstone. Trout have not been seen above Osprey Falls.

In Soda Butte Creek trout are numerous until obstructed by falls in the upper part.

Hellroaring Creek is well stocked in the lower part.

In Canyon Creek trout abound below the falls.

It is stated on good authority that, notwithstanding the barrier offered by Undine Falls, trout occur above in Lupine and Lava Creeks. It appears that in 1889 trout obtained from Howard Creek, Idaho, were planted in Lava Creek. However, it was subsequently ascertained that trout had possible access to this locality from Blacktail Deer Creek, which has no falls and was abundantly supplied with trout.

Trout are numerous in Heart Lake and, according to A. H. Dinsmore, in Lewis River below the falls.

The size attained by trout in the park waters, as elsewhere, varies much with locality and conditions. Fish of over 4 pounds have been reported.

This trout in some waters is a highly esteemed game fish and can be taken in all sorts of ways—spoon, phantom, natural bait, artificial fly, etc. Mary Trowbridge Townsend (l. c.) writes of it in the Fire-hole River:

The father of the Pacific trout, the blackspotted "cutthroat" with the scarlet splotch on his lower jaw, was most in evidence, with long symmetrical body, graduated black spots on his burnished sides. He is a brave, dashing fighter, often leaping salmon-like many times from the water before he can be brought to creel. We found him feeding on the open riffs or rising on the clear surface of some sunlit pool.

Ralph E. Clark wrote (l. c.) that "the dark, silvergray trout of the West seem to favor flies more in harmony with their own coloring," and mentioned the gray hackle, brown hackle, coachman, grizzly king, Seth Green, black gnat, and white moth:

The junction of Yellowstone and Lamar Rivers is noted for fine fishing. If you find the waters high, swift, and roily, you will probably try your flies in vain. Put on a spinner or a little spoon and watch the fish rise to it, almost touch it, and then go away. They are after live bait and won't touch anything else. The grasshoppers are abundant. Catch a few, bait your hook carefully, and let it float down with the current. A large trout will rise to it, and if you are not very careful he will steal it from you.

This is an excellent food fish when fresh from cool waters, but the trout from some parts of the Yellowstone Lake, Upper Yellowstone River, and Heart Lake are generally reputed to be infested with a parasitic worm. In his book previously cited in the list of publications pertaining to the fish of the park, Gen. Chittenden says:

The trout of Yellowstone Lake are to a slight degree infected with a parasitic disease that renders them unfit for eating. Many efforts have been made to discover the cause of this condition and a suitable remedy for it, but so far without success. An explanation sometimes advanced is that the excessive number of these fish and the absence of sufficient food reduce the vitality and they become an easy prey to parasites which a more vigorous constitution would throw off. Later investigations have shown that reports of the prevalence of this condition were much exaggerated.

The parasite referred to is a tapeworm, of which only the larval or intermediate form occurs in the trout, the host of the adult being an entirely different animal, as is the case with all tapeworms of this kind. Briefly, its life cycle has been found to be as follows: Starting with the egg in the water, it develops into a ciliated embryo. This passes into the fish, probably by way of the mouth, and becomes established and assumes the form usually observed. The fish is eaten by the pelican, and in the intestinal tract of that bird the parasite attains its adult and reproductive stage, and its round of life is there completed. The eggs pass into the water and a new generation is begun.

Gen. Chittenden's statement that the parasite renders the fish unfit for food involves a matter of prejudice rather than actual unfitness for food or danger to the consumer. Cooking destroys the vitality of the worm, and it may be said that this particular worm is not harmful to man. Probably no one would knowingly eat an infected fish, but if he should there would be absolutely no danger in doing so. Beyond doubt the presence of this parasite is greatly exaggerated, as Gen. Chittenden says, and lean, cadaverous, un-

sightly trout, the condition of which is commonly attributed to parasitism, are often fish which are run down from breeding, although they may carry some parasites. There is scarcely a fish that swims that is not more or less infected by some sort of parasitic worm, and in this respect the Yellowstone fish do not appear to be worse than fish of many other lakes in the country.

It has been said that there are two varieties of native trout in the park, the larger ones of the Yellowstone, with bright yellow bellies, and the smaller kind more silvery in appearance and exhibiting much greater activity and game qualities, of which Tower Creek fish are examples. Also trout of Yellowstone Lake seem to differ from those of Heart and Henry Lakes in having more distinct and rather less numerous black spots. However, in this respect very much individual variation is shown.

This is the principal fish artificially propagated by the United States Bureau of Fisheries at the hatcheries on Yellowstone Lake and Soda Butte Creek. From three to twenty million eggs are taken annually. After the local park waters are liberally stocked the remaining young are supplied to suitable waters in the adjoining States. The park, however, should and does have the first and major claim on the hatchery output.

4. RAINBOW TROUT (*Salmo shasta*).

The rainbow trout has its geographical range in the mountain streams of the Coast Range and the western slopes of the Sierra Nevada Mountains, but the natural abode of the rainbow trout of fish-cultural fame is the McCloud River, Calif. This form, now recognized as a species distinct from *Salmo irideus*, bears the name of *Salmo shasta*. It has been successfully introduced into many streams in different parts of the United States where it was not previously found.

The rainbow, first introduced into the park in the Gibbon River in 1880 and subsequently planted in various waters and on numerous occasions, has become one of the most abundant, most widely distributed, and most popular of the park fishes. The waters stocked, in addition to the Gibbon River above and below the falls, have included the Gardiner River, tributaries of Yellowstone Lake, and various small lakes.

The size attained by the rainbow trout varies greatly and is dependent upon volume of water, temperature, food supply, etc. Under certain conditions it reaches an extraordinary size, but in the ordinary environment 6-pound or 8-pound fish are to be regarded as large. In general, it may be said that the fish does not overrun 2 pounds. Its food is composed largely of insects.

This fish now abounds in the Gibbon River both above and below Virginia Cascades, and good fishing is found at times at the junction with the Madison. Regarding this stream the park superintendent's report for 1897 shows that the fish planted above the cascades seemed to have come down over the falls, as but few were found above, while below the stream was well stocked to its junction with the Firehole. In the Gibbon River above the falls it appears that the supply has been greatly depleted, in fact, nearly fished out, owing to the cir-

cumstance that the road follows the stream for many miles, and there must have been thousands of anglers fishing there in 1919, according to the senior author's notes of July, 1919. Grebe Lake, Blacktail Deer Creek, Madison, Firehole, and Little Firehole Rivers all contain rainbow trout. Referring to the last-named stream in 1897, the superintendent of the park wrote that several good specimens had been taken near its source, for which he could not account, as it seemed impossible for any fish to ascend the lower falls of the Little Firehole. A. H. Dinsmore reports the fish from Tower Creek above the falls.

Many persons who have had experience in angling for rainbow trout say it is one of the best, and some pronounce it the very best, of the trouts. It often dashes from the water to meet the descending fly and leaps repeatedly and madly when hooked. It has been said that it takes the fly so readily that there is no reason for resorting to other lures. However, its activity and habits, as in the case of most fishes, are modified more or less by its surrounding conditions. The same is true of its food qualities, which ordinarily are very good.



FIG. 4.—Rainbow trout.

Mary Trowbridge Townsend (l. c.) had the following to say relative to her experience with the rainbow trout in Firehole River:

The California rainbow trout proved true to his reputation as absolutely eccentric and uncertain, sometimes greedily taking a fly and again refusing to be tempted by the most brilliant array of a carefully stocked book. During several days' fishing we landed some small ones, none weighing over 2 pounds, although they are said to have outstripped the other varieties in rapidity of growth, and tales were told of 4-pounders landed by more favored anglers.

5. SCOTCH LAKE TROUT: LOCH LEVEN TROUT (*Salmo levenensis*).

This trout originated in Loch Leven, the lake made famous by Scott's poem, "The Lady of the Lake." Typically it was peculiar to this loch, where it seldom if ever attained much over 1 pound in weight. The claim has been made that it is merely an ontogenetic development of the common brown trout, and that when transferred to other waters its progeny can not always be distinguished from the common brown trout. On the other hand, information derived from persons familiar with Loch Leven indicates that both this trout and the brown trout exist in the same lake, and that in that body of water they can always be distinguished.

It is not impossible that confusion has arisen by brown trout from that lake having been propagated under the supposition that they were Loch Leven trout. There are parallel instances of such mistaken identity in this country in respect to other species, and so-called Loch Leven trout have been propagated for a long time in this country. In the early years the progeny of Loch Leven eggs could easily be distinguished from brown trout hatched at the same time, especially when they had attained a few inches in length. Recently, however, there is reason to suspect that many of the so-called Loch Leven plants have been brown trout. Be that as it may, trout under each name have been introduced into Yellowstone Park waters, and there are records of both having been subsequently taken. The first plants of this trout in the park were made in the upper part of the Firehole River in 1889. The next year Lewis Lake and Shoshone Lake were stocked, and in 1903 further plants were made in tributaries of the Firehole.

The Loch Leven trout has been taken in the following park waters, in some of which it is abundant: Firehole River above and below the cascades, Madison, Gibbon, and Gardiner Rivers, Shoshone and Lewis

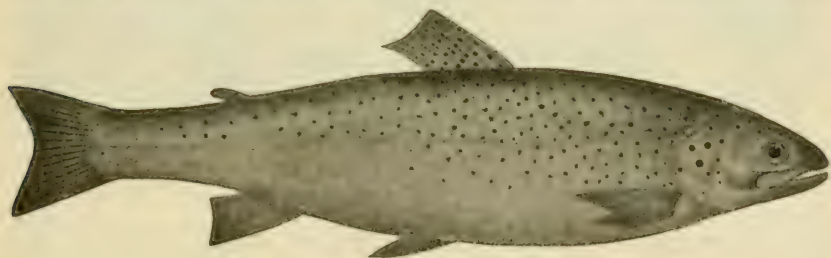


FIG. 5.—Scotch lake trout: Loch Leven trout.

Lakes and the "canal" connecting those lakes, upper Snake River waters, Heron Creek, and Duck Lake, near the Thumb of Yellowstone Lake.

Fish of large size and in great abundance were found in Duck Lake in 1919. Landlocked salmon had been planted in this lake in 1908 and were reported to have survived and flourished, but none have ever been authentically identified, and it seems likely that the Loch Leven trout, the history of whose introduction into this lake is quite obscure, have been mistaken for landlocked salmon. Hundreds of fish were observed jumping at times, and a number of specimens up to 4 pounds in weight were taken in the summer of 1919 after a game fight.

6. EUROPEAN BROWN TROUT; VON BEHR TROUT (*Salmo fario*).

The brown trout is widely distributed in continental Europe and the British Isles, inhabiting lakes as well as streams, but it is the "brook trout" of the continental European countries. Under favorable conditions it is known to grow to over 20 pounds, but as a true brook trout it seldom registers over 1 pound in weight.

The brown trout thrives in clear, cold, rapid streams and at the mouth of streams tributary to lakes, having much the same habits

as our eastern brook trout. It is by some regarded highly as a game fish, taking either bait or artificial fly. The best fly fishing is usually toward night. As a game and food fish it is in its prime from May to September. Its flesh is very agreeable in flavor. Spawning begins in October.

The brown trout has a rather extensive distribution in the park, although only a single plant of 9,300 fish was made in Nez Perce Creek in 1890. The fish now inhabits the Madison, Gibbon, and Firehole Rivers. In the last named it is found from its junction with the Gibbon to Keppler Cascades and is particularly numerous in Nez Perce Creek, Little Firehole River below Mystic Falls, and Iron Creek. In the main streams fish have been taken weighing up to 8 pounds. In the park, as elsewhere, the brown trout has the reputa-



FIG. 6.—European brown trout; Von Behr trout.

tion of being antagonistic to other trouts and of increasing in size and abundance at the expense of the others.

Mary Trowbridge Townsend, in her interesting article on trout fishing in the park (l. c.), mentioned a brown trout from the Firehole River:

A good 4-pounder, and unusual marking, large yellow spots encircled by black, with great brilliancy of iridescent color. * * * I look afterwards several of the same variety, known in the park as the Von Behr trout, and which I have since found to be the same *Salmo fario*, the veritable trout of Izaak Walton.

7. LAKE TROUT: MACKINAW TROUT (*Cristivomer namaycush*).

The lake trout, otherwise known as laker, lunge, togue, Mackinaw trout, etc., is of wide northern distribution. In British America it ranges from the Atlantic to the Pacific coasts and northward to the Arctic Ocean. In the United States it is found in many of the larger and deeper lakes in New England and New York, in the Great Lakes Basin, and in a few localities in the Western States, as Montana and Idaho. It occurs also in Alaska. It has also been spread by fish-cultural operations into waters where it did not previously exist.

The lake trout owes its presence in the park to two plants of 30,000 and 12,000 fingerlings in Shoshone Lake and Lewis Lake, respectively, in 1890. The fish is now common in those waters, especially around the shores, and was formerly taken in large quantities to supply the park hotels. It is found also in the "canal" connecting the two large lakes. In some waters it attains a very large size. Examples weighing over 100 pounds have been reported from the Great Lakes,

and in former years the average weight of the fish in the commercial fisheries of those waters was stated at 20 to 30 pounds. At this time, however, 10 to 15 pounds can be considered large.

Park Ranger Dewing reports that in 1915 he saw a lake trout that weighed 32 pounds caught in Shoshone Lake by a soldier. Mounted specimens of two large lake trout from Shoshone Lake are in the lobby at Old Faithful Inn. One taken July 13, 1912, by Pete Bergendorf, hotel fisherman, weighed 12 pounds, the other, 39 inches long, weighed 21 pounds. In the summer of 1911 Howard Eaton with a party fished in Lewis Lake and in one day caught 200 pounds of lake trout. The largest fish was 39½ inches long and weighed 20 pounds; another was 34 inches long.

According to A. H. Dinsmore, as early as 1901 the lake trout had spread from Lewis Lake and become abundant in Lewis River below the upper falls. The fish has been reported also below Idaho Falls and has passed up through the tributary coming from Jenny Lake, in which water it occurs in numbers about equal to the native trout,

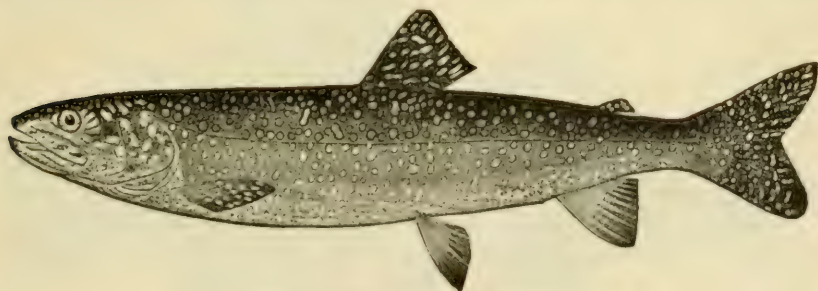


FIG. 7.—Lake trout; Mackinaw trout.

and specimens are recorded from the Buffalo Fork of the Snake River.

The large size of the lake trout affords its chief attraction as a game fish, for it is not ordinarily a very active fighter, although a powerful antagonist. It is usually caught by deep trolling, but is sometimes found at the surface and is occasionally taken on an artificial fly. The fish may be caught by trolling or casting with artificial or natural baits.

Opinions differ regarding its table qualities, and, as with most fishes, much depends upon how it is prepared and cooked. It is a very oily fish and often has an unpleasant, strong, oily flavor. This may be obviated, however, by removing the skin before the fish is cooked. The best method of cooking it is by boiling, serving with mayonnaise dressing or egg sauce.

Mr. Clark (l. c.) wrote in 1908 that the lake trout were plentiful in Shoshone Lake and Lewis Lake and River, and that they could be caught in the canal between Shoshone and Lewis Lakes as fast as one could throw in a trolling spoon, and he remarked that they were large and fat. On August 6, 1919, Mr. Dinsmore caught a 4-pound fish on a feathered spinner, in the canal off Point of Rocks.

S. EASTERN BROOK TROUT; SPECKLED TROUT (*Salvelinus fontinalis*).

The natural western limit of this brook trout in the United States is northeastern Minnesota. It inhabits lakes as well as streams and varies in size according to locality. It does not flourish in water temperature over 68° F., and about 50° F. is preferable. The largest trout of this species authentically recorded weighed somewhat over 12½ pounds. In some lakes trout of 5 or 6 pounds are not uncommon, but such large fish are seldom found in streams unless the streams are tributary to fairly large lakes. In streams of moderate size trout of 1 or 2 pounds' weight are to be considered large, and in most brooks a trout of one-half or three-fourths pound is an exception, at least in recent years. Its spawning season is in fall.

Plants of eastern brook trout have been made by the Bureau of Fisheries in various park waters, and the fish is now abundant and widely distributed. It is known to occur in Gardiner River and its tributaries with their branches, particularly those of the west side: Glen, Fawn, Panther, Indian, Willow, Winter, Straight, and Obsidian

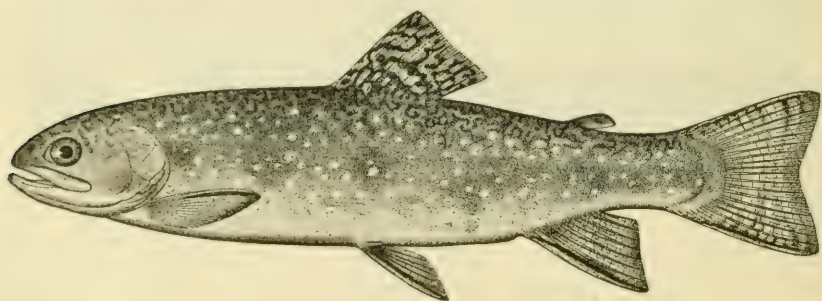


FIG. 8.—Eastern brook trout; speckled trout.

Creeks; Swan, Grizzly, and Beaver Lakes; Gibbon and Madison Rivers; Solfatara Creek; Virginia Meadows; Firehole River, above Kepler Cascades, where, according to the 1897 report of the superintendent of the park, this trout was very abundant, and between its junction with the Gibbon and the lower falls; Upper Little Firehole; Upper Nez Perce Creek, but, according to Park Ranger Dewing, not in lower Nez Perce. According to Mr. Dinsmore it is found in Juniper Creek, a tributary of the Upper Nez Perce, and it occurs in Lone Star Creek and Spring Creek. Tower and Carnelian Creeks above the falls contain it, according to Mr. Dinsmore. It is abundant in Shoshone Creek, and according to the park superintendent's 1897 report that creek was alive with brook trout up to 1½ pounds in weight. Small fish are found in lower De Lacy Creek.

The brook trout is one of the most noted and esteemed of American game fishes, but there must be something besides activity that makes it such a general favorite, as in that respect it is surpassed by several others. One appealing attribute is its beauty of coloration, and another its delicacy of flavor, which is hardly surpassed by any other fish.

The brook trout may be taken by almost any method known to anglers. In open streams fly fishing is the method par excellence.

In streams where overgrowth prevents fly casting, angleworms, grasshoppers, or almost any bait will be taken when the trout is feeding. Everything will be disregarded when it is not feeding. The best flies to use in any body of water must be learned by experience, but the brown hackle is seldom a failure anywhere. Professor, queen of the water, Montreal, coachman, and many others are usually quite successful. Gauze-winged flies will sometimes succeed when others fail. The best time to fish for this trout is in the morning and early evening. It lurks in eddies and pools and at the foot of rapids or under overhanging banks, old stumps, or rocks.

9. YELLOW PERCH (*Perca flavescens*).

The yellow perch has a wide eastern distribution. It is common in the Great Lakes and the tributaries of the upper Mississippi River

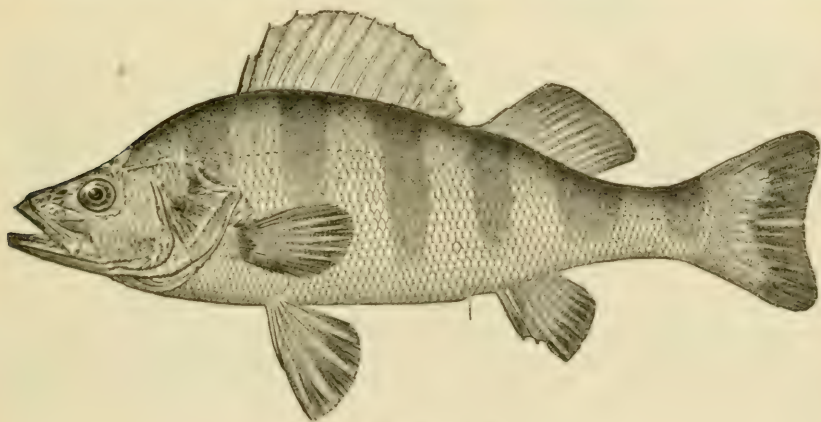


FIG. 9.—Yellow perch.

and in coastwise streams and lakes from Nova Scotia to North Carolina.

In 1919 this fish was found by the senior author to abound in Goose and Feather Lakes in the park. Its presence there is apparently traceable to an unofficial, unauthorized plant made many years ago by a Montana citizen, who is said to have obtained a consignment of yellow perch from the State of Washington, into which State the species had been introduced some years before.

In the park lakes the yellow perch attains a length of a foot and is most readily caught by the use of small spinners cast from shore and rapidly drawn in. Only a few of the park authorities have been aware of the occurrence of this fish in local waters. It can not be regarded as a desirable addition to the fish life of the park, and its spread to other waters than those now inhabited should be prevented. It is not usually reputed to be a game fish, and its voracious habits make it a menace to young trout. When fresh from cold water, it is one of the best of pan fishes, being firm-meated and of delicious flavor.

10. BLOB (*Cottus punctulatus*).

This little sculpin belongs in the Missouri Basin and abounds in some of the waters of the park. It has been reported to swarm in the grassy-bottom portions of the Madison and Gibbon Rivers and in Canyon Creek and to be numerous in the Gibbon above the falls. It



FIG. 10.—Blob.

is known also from the Firehole below the falls. The presence of this fish in the Gibbon River above the falls is a freak in distribution that has not been explained. The blob is probably justly accused of being destructive to the eggs of other fishes and appears to be of little use, unless possibly as bait for large trout. It can be taken with a small baited hook. It attains a length of 5 inches.

11. LONGNOSE SUCKER (*Catostomus catostomus*).

This species is of wide natural distribution in northern waters, its geographical range being from the Pacific to the Atlantic coasts and into the Arctic regions. It attains a length of 18 inches and a weight of several pounds. Its spawning time is spring and early summer

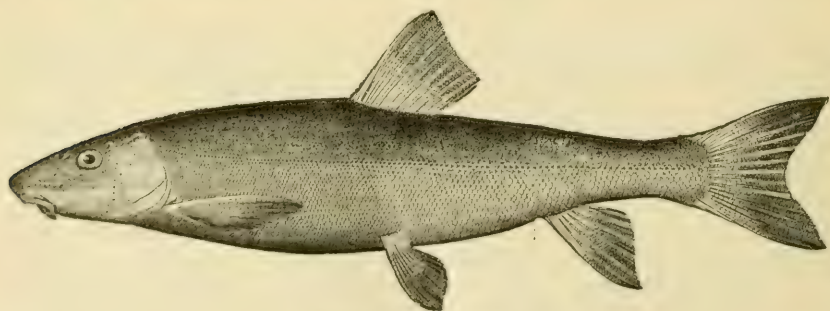


FIG. 11.—Longnose sucker.

when the males have their anal fin profusely covered with tubercles and the side of the body with a broad red stripe more or less diffuse on the edges. It is not sought as a game fish, but sometimes takes a baited hook and fights fairly well. When taken from cool water and cooked at once it is a good-flavored pan fish, although somewhat bony. It is abundant in Yellowstone and Gardiner Rivers below the Osprey, Undine, and Rustic Falls.

12. ROSYSIDE SUCKER (*Catostomus ardens*).

This sucker is abundant in the Snake River Basin above Shoshone Falls. It is reported from Heart Lake and Witch Creek and is said to ascend the latter into very warm water flowing from Heart Lake Geyser Basin. Like the longnose sucker, it spawns in spring

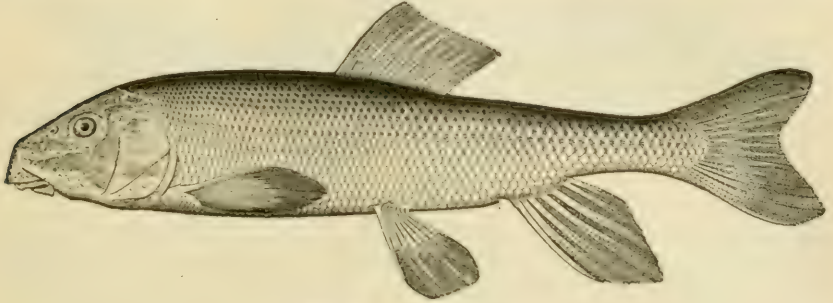


FIG. 12.—Rosyside sucker.

or early summer. It will also take a baited hook and is edible but not as palatable as the other sucker. In Heart Lake and Witch Creek the alimentary tract of this sucker is infested by parasitic worms, which, although offensive to the eye, do not render the fish harmful as food. Affected fish, however, are likely to be lean and unpalatable.

13. CHUB (*Leuciscus lineatus*).

This chub, known in the books as Utah Lake chub, is one of the most widely distributed of the genus and abounds in the Snake River Basin above Shoshone Falls; also in Yellowstone Lake and other places in the park. Chubs from cool water are not to be despised

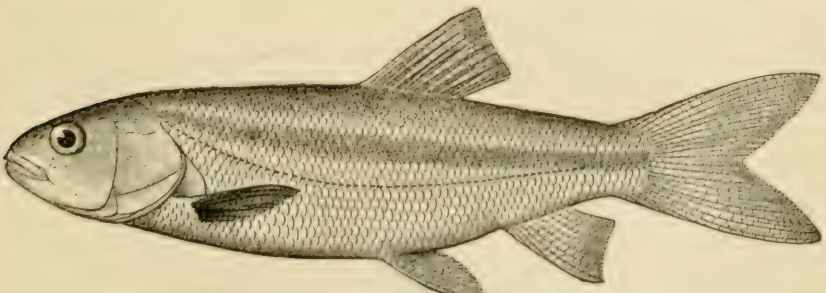


FIG. 13.—Chub.

in game and food qualities. The species reaches a length of 12 or 15 inches or more and is said to be destructive to the eggs and young of trout. No worms have been found in its alimentary canal. It spawns in spring and early summer.

Dr. Jordan says: "Chubs ascend Witch Creek until they reach water fairly to be called hot, and the sucker is not far behind," enduring a temperature of 88° F.

14. SILVERSIDE MINNOW (*Leuciscus hydrophlox*).

This little fish is too small to be of much use for other than food or bait for trout, attaining a length of only 3 to 5 inches. It occurs

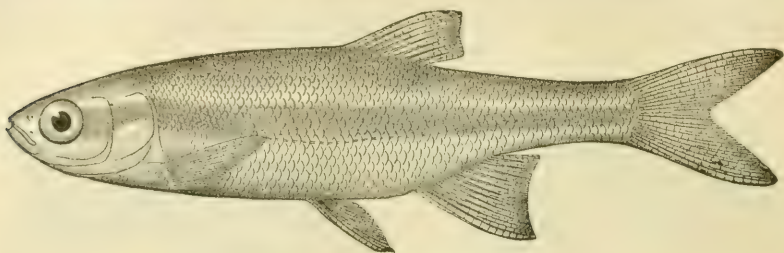


FIG. 14.—Silverside minnow.

in some of the sources of the Snake River in the park, particularly Heart Lake and Witch Creek. It spawns in spring.

15. LONGNOSE DACE (*Rhinichthys dulcis*).

This little minnow, attaining a maximum length of only about 5 inches, is food for trout and useful as bait. It is found in Heart

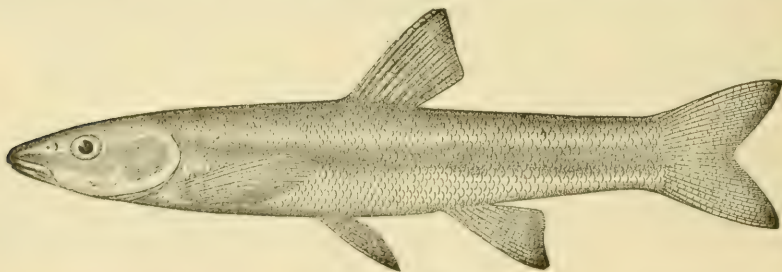


FIG. 15.—Longnose dace.

Lake and Witch Creek and also in Gardiner River below Osprey, Undine, and Rustic Falls.

16. DUSKY DACE (*Agosia nubila*).

The little dusky dace, seldom over 3½ inches in length, is extremely abundant and widely distributed in the Columbia River Basin. In



FIG. 16.—Dusky dace.

the park it has been recorded from Heart Lake and Witch Creek. It is useful as food for larger fishes and as bait for trout.

FOOD OF YOUNG WINTER FLOUNDERS.¹

By EDWIN LINTON,

Temporary Investigator, U. S. Bureau of Fisheries.

Contribution from the U. S. Fisheries Biological Station, Woods Hole, Mass.

In connection with work on the parasites of fishes it has been the author's practice to keep a record of the food of the fishes which were being examined for Entozoa. Such miscellaneous data, while not without value, are lacking in that definiteness which is afforded by quantitative studies. It was therefore suggested by the Bureau of Fisheries that an intensive study of the food of one or two families or groups of fishes, preferably those of economic importance, be undertaken.

During the summers of 1915 and 1916 the author spent a part of his time in the examination of small winter flounders (*Pseudopleuronectes americanus*) for their food. The fish were seined by Vinal N. Edwards at 36 stations at Woods Hole, Mass., and vicinity, on dates ranging from May 2 to November 2. The total number of fish examined was 398.

Fishes collected in the months of May, June, September, October, and November were preserved in formaldehyde and examined in the summer of 1916. Fish seined in July and August were brought to the laboratory soon after they were taken from the water. If taken at some distance from the laboratory, they were placed in a strong preservative as soon as they were taken from the water. At first the smaller fish were preserved entire in 95 per cent alcohol, after opening the abdominal cavity. The viscera of the larger fish were removed and kept in dishes of formaldehyde. It was soon found that the formaldehyde material was the more satisfactory for study, and, when well washed in water, could be looked over without discomfort. In each case the alimentary canal was opened throughout its entire length and examined in alcohol or water. The material was separated with the aid of a dissecting lens, the compound microscope being used when necessary for the identification of material. Quantitative estimates were then made, using the smallest lot as a unit.

It often happens that much of the contents of the alimentary canal of the fish does not admit of satisfactory separation into distinct lots, even when its general character is more or less identifiable. For example, in cases where annelids, having much sand in their intestines, have been eaten, what at first appeared to be a mass of

¹ Appendix IV to the U. S. Report of the Commissioner of Fisheries for 1921. B. F. Doc. 907.

sand, upon closer examination proved to contain setæ of annelids, with occasional shreds of cuticle. As the body of the annelid is being digested, the intestine, gorged with sand and mud, often remains in a condition that admits of identification as annelid remains. It is doubtless true that much of the material recorded as ostracodes and small univalve shells has been introduced with annelids.

In the beginning of this work the author was often greatly puzzled when attempting to determine the quantitative values to be placed on the different food materials. After some practice, however, one develops a method which takes into account such material as can readily be separated and classified, and often makes it possible to reduce the unidentified débris to small proportions. In view of the nature of the food of many annelids it is to be noted that the percentage of materials counted as annelid does not always indicate similar percentage of food ingested. Doubtless, also, especially in the beginning of these studies, the estimated percentage of débris is sometimes larger than it should be, due to the fact that portions of the mucous membrane, which are detached when the contents of the alimentary canal are removed, become mixed with the food proper.

Plant material was noted in only 20 of the flounders, approximately 5 per cent of the whole number examined for food. In all instances where plant remains were noted in the contents of the alimentary canal, the amount was always both absolutely and relatively small. Usually it consisted of a few fragments of filamentous algæ, the presence of which could be accounted for as material which had accidentally been taken in along with the proper food of the fish. No place, therefore, was given for plant remains in the table of quantitative estimates.

It would seem, however, that the winter flounders may, on occasion, make use of plant food. From unpublished food notes made in connection with the examination of winter flounders for parasites, mostly by Vinal N. Edwards, out of 82 examinations, 23 records note the presence of plant remains in the alimentary canal. In some cases considerable amounts of plant material were present. Thus, on three dates—April 14, November 7, and 12—the record reads, "Stomachs filled with eelgrass;" on August 31, "Stomach and intestine filled with green seaweed;" on September 30, "Stomach full of algæ (*Ulva*)."

It is likely that the eelgrass is eaten for the incrustations of the tunicate *Botryllus gouldii*.

A detailed account of the results of the examination of each of the 398 small flatfish would make a very bulky report, and is considered unnecessary. Illustrative details, omitting some of the notes on Entozoa, are here given for one station only.

FOOD AND ENTOZOAN PARASITES OF SMALL WINTER FLOUNDERS.

STATION 19. KATAMA BAY, JULY 27, 1915.

[Fish seized in water 1 to 4 feet in depth. Bottom, sand with red seaweed and other algæ. The bay had been closed on the ocean side for the preceding six years; there was, therefore, little current produced by the tide. Winter flounders, few. Figures referring to food represent average per cent of volume; lengths are given in millimeters.]

1. *Length, 28*.—Food: Copepods, 95; débris, 5. Entozoa: 141 appendiculate distomes, 1 ivory-white sporozoan cyst on intestine.

2. *Length, 30*.—Food: Alimentary canal empty. Entozoa: 317 appendiculate distomes in stomach, 6 in intestine.

3. *Length, 31.*—Food: Copepods, 95; débris, 5. Entozoa: 247 appendiculate distomes in stomach.

4. *Length, 31.*—Food: Copepods, 30; débris, mostly sand, 70; alimentary canal nearly empty. Entozoa: 145 appendiculate distomes in stomach.

5. *Length, 37.*—Food: Amphipods, 50; copepods, 10; débris, 40. Entozoa: 3 appendiculate distomes in stomach.

6. *Length, 37.*—Food: Annelids, 40; copepods, 10; zoæ, 10; ostracodes, 10; amphipods, 10; débris, 20; small fragment of Sagartia. Entozoa: 12 appendiculate distomes in stomach, 4 small nematodes.

7. *Length, 40.*—Food: Amphipods, 20; cumacea, 20; copepods, 5; Crepidula, 5; ostracodes, 5; annelids, 30; débris, 15. A small fragment of the body wall of a synapta was noted. Entozoa: 200 appendiculate distomes in stomach.

8. *Length, 43.*—Food: Amphipods, 10; zoæ, 10; copepods, 10; annelids, 60; débris, 10. Entozoa: 24 appendiculate distomes in stomach.

9. *Length, 44.*—Food: Amphipods, 65; copepods, 10; ostracodes, 4; Sagartia, 5; nemerteans, 5; Crepidula, 5; débris, 6. Entozoa: 24 appendiculate distomes in stomach, 3 in intestine; 4 small nematodes, length 5.

10. *Length, 44.*—Food: Amphipods, 25; ostracodes, 25; copepods, 25; Crepidula, 5; débris (fragments of crustacea), 20; 1 zoæ noted. Entozoa: 80 appendiculate distomes in stomach, 3 small nematodes.

11. *Length, 48.*—Food: Amphipods, 90; débris, 10; one small insect larva (Chironomus) noted. Contents of alimentary canal almost completely digested, its nature revealed only when the compound microscope was used. Entozoa: 4 distomes.

12. *Length, 49.*—Food: Amphipods, 90; débris, 10; 1 insect larva noted.

13. *Length, 52.*—Food: Amphipods, 80; Crepidula, 20.

14. *Length, 58.*—Food: Amphipods, 100.

15. *Length, 115.*—Food: Amphipods, 50; Crepidula, 10; débris, 40; 1 small annelid noted. Entozoa: A few sporozoan cysts on wall of intestine.

16. *Length, 120.*—Food: Amphipods, 95; crabs, 1; Crepidula, 2; débris, 2. Entozoa: Sporozoan cysts on intestine.

17. *Length, 120.*—Food: Amphipods, 80; crabs, 10; Crepidula, 2; débris, 8. Entozoa: A few sporozoan cysts on intestine.

18. *Length, 120.*—Food: Amphipods, 15; crabs, 15; Limulus, 15; Crepidula, 5; annelids, 45; débris, 5.

19. *Length, 125.*—Food: Annelids, 95; débris, 5.

20. *Length, 130.*—Food: Limulus, 2; clams, 50; Crepidula, 15; annelids, 3; débris, 30; a few strands of algæ. Entozoa: 1 distome.

21. *Length, 135.*—Food: Amphipods, 98; crabs, 2. Entozoa: 2 distomes.

22. *Length, 135.*—Food: Amphipods, 60; crabs, 30; shrimp, 5; gastropods, 5.

23. *Length, 140.*—Food: Amphipods, 5; crabs, 2; Limulus, 1; bivalve mollusks, 2; annelids, 90. The mollusks were a small Crepidula and fragments of a small clam. Entozoa: 3 distomes.

24. *Length, 150.*—Food: Amphipods, 8; spider crabs, 3; clam, 1; annelids, 80; débris, 8.

25. *Length, 170.*—Food: Nothing in alimentary canal that could be identified except a few fragments of algae and what appeared to be remains of the mantles of clams. Entozoa: 1 distome.

26. *Length, 190.*—Food: Amphipods, 5; mollusks (small clam and small gastropod), 15; annelids, 75; débris, 5. Entozoa: 2 distomes.

SUMMARIZED RECORD OF FOOD AND PARASITES OF 398 SMALL WINTER FLOUNDERS (PSEUDOPLEURONETES AMERICANUS) COLLECTED AT WOODS HOLE, MASS., AND VICINITY, 1915 AND 1916.

[Figures referring to food represent average per cent of volume; figures referring to parasites, where not otherwise indicated, represent numerical average. The lengths are given in millimeters. The stations have been arranged according to dates as if of one year.]

STATION 1. GREAT HARBOR, MAY 2, 1916.

Length, 26 to 50.—Number examined, 1. Food: Amphipods, 85; Cumacea, trace; insect larvæ, 1; débris, 14. Parasites: Distomes, 4.

Length, 51 to 75.—Maximum length, 72; minimum, 64; average, 70.8. Number examined, 4. Food: Amphipods, 48.8; annelids, 17.5; copepods, trace; insect larvæ, 1.5; débris, 32.2. Parasites: Distomes in each, average 16; Sporozoa, 8 small cysts on intestinal walls of one.

Length, 76 to 100.—Maximum length, 97; minimum, 76; average, 87.7. Number examined, 3. Food: Amphipods, 20; annelids, 48.3; shrimp, 30; débris, 1.6. Parasites: Distomes, 2.3; nematodes, 1 young Ascaris in stomach of one fish.

STATION 2. EEL POND, MAY 16, 1916.

Length, 51 to 75.—Maximum length, 68; minimum, 58. Number examined, 2. Food: Amphipods, 67.5; annelids, 12.5; Cumacea, 10; isopods, trace; débris, 10. Parasites: Distome, 1, in one fish.

Length, 101 to 125.—Maximum length, 125; minimum, 102; average, 113.2. Number examined, 5. Food: Amphipods, 79; annelids, 4.6; Cumacea, 0.2; insect larvæ, 2.4; isopods, trace; débris, 13.8. Parasites: Distomes, 1 in one fish; nematodes, 1 in one fish; Sporozoa, masses of cysts on lower half of intestinal wall of three.

STATION 3. GREAT HARBOR, JUNE 27, 1916.

[Bottom, sandy.]

Length, 25 to 50.—Maximum length, 42; minimum, 25; average, 34.9. Number examined, 12. Food: Amphipods, 20.4; annelids, 24; copepods, 4.7; débris, 51. Parasites: Distomes in each fish, average 35.4.

STATION 4. SHEEP-PEN COVE, JUNE 27, 1916.

[Bottom, muddy with some eelgrass.]

Length, under 25.—Length, 24. Number examined, 1. Food: Amphipods, 1; annelids, 22; copepods, 73; débris, 4. Parasites: Distomes, 10.

Length, 26 to 50.—Maximum length, 38; minimum, 28; average, 33.8. Number examined, 13. Food: Amphipods, 59.7; annelids, 11.8; copepods, 6.3; ostracodes, 0.8; Cumacea, trace; débris, 21.4. Parasites: Distomes, 21.4.

STATION 5. WAREHAM RIVER, JUNE 30, 1916.

[Bottom, mud and eelgrass.]

Length, 26 to 50.—Length, 32. Number examined, 1. Food: Amphipods, 10; annelids, 50; débris, 40. Parasites: Distomes, 18.

Length, 100 to 125.—Maximum length, 120; minimum, 113; average, 116.2. Number examined, 5. Food: Amphipods, 4.2; annelids, 54.8; bivalve mollusks, 0.2; insect larvæ, trace; débris, 40.8. Parasites: Distomes, 10.2; Sporozoa, numerous cysts on intestine of one fish, 1 cyst on intestine of another.

STATION 6. HADLEY HARBOR, JULY 1, 1916.

[Bottom, eelgrass and sand.]

Length, under 25.—Length, 23. Number examined, 1. Food: Amphipods, 5; copepods, 90; débris, 5. Parasites: Nematodes, 1.

Length, 25 to 50.—Maximum length, 44; minimum, 25; average, 35.2. Number examined, 13. Food: Amphipods, 63.4; annelids, 0.4; copepods, 25.7; ostracodes, 2.9; shrimp, 0.5; débris, 6.6. Parasites: Distomes, 0.5.

STATION 7. HEAD OF LACKEY'S BAY, JULY 1, 1916.

[Bottom, eelgrass and mud.]

Length, under 25.—Maximum length, 23; minimum, 21. Number examined, 2. Food: Amphipods, 16; annelids, 2.5; copepods, 70; Cumacea, 0.1; insect larvæ, 1.5; ostracodes, 3.5; débris, 6.5.

Length, 25 to 50.—Maximum length, 42; minimum, 27; average, 35.2. Number examined, 12. Food: Amphipods, 32.3; annelids, 15.9; copepods, 13.5; Cumacea, 0.1; insect larvæ, 0.2; ostracodes, 1; débris, 37. Parasites: Distomes, 6.2.

STATION 8. SHEEP-PEN COVE, JULY 11, 1916.

[Bottom, mud and eelgrass.]

Length, under 25.—Length, 22. Number examined, 1. Food: Copepods, 50; débris, 50.

Length, 25 to 50.—Maximum length, 50; minimum, 29; average, 37.7. Number examined, 13. Food: Amphipods, 33.9; annelids, 7; copepods, 22.1; Cumacea, 0.8; insect larvæ, 0.2; ostracodes, 0.8; débris, 36.2. Parasites: Distomes in each fish, maximum, 484; minimum, 17; average, 155.3.

STATION 9. HEAD OF GREAT HARBOR, JULY 11, 1916.

[Bottom, sandy.]

Length, under 25.—Length, 24. Number examined, 1. Food: Amphipods, 10; copepods, 10; débris, 80. Parasites: Distomes, 27.

Length, 25 to 50.—Maximum length, 50; minimum, 26; average, 33.7. Number examined, 10. Food: Amphipods, 18; annelids, 25.6; copepods, 17.2; larval Crustacea, trace; débris, 39.1. Parasites: Distomes in each fish, maximum, 154; minimum, 3; average, 46.9. One fish (50 mm. in length) had nothing in the alimentary canal except distomes, of which there were 154 in the stomach.

Length, 51 to 75.—Maximum length, 57; minimum, 51; average, 54.3. Number examined, 3. Food: Amphipods, 81.6; annelids, 6.7; copepods, 6.7; débris, 5. Parasites: Distomes in each fish, maximum, 125; minimum, 30; average, 92.6.

STATION 10. TARPAULIN COVE, JULY 14, 1916.

[Soft bottom, with eelgrass.]

Length, 25 to 50.—Maximum length, 50; minimum, 44; average, 48.1. Number examined, 7. Food: Amphipods, 82.1; copepods, trace; isopods, 2.5; ostracodes, trace; débris, 15.3.

Length, 51 to 75.—Maximum length, 55; minimum, 54. Number examined, 2. Food: Amphipods, 72.5; isopods, 2.5; débris, 25.

STATION 11. MENEMSHA BIGHT, JULY 14, 1916.

[Bottom, sand and eelgrass.]

Length, 101 to 125.—Maximum length, 120; minimum, 101; average, 109. Number examined, 5. Food: Amphipods, 74.2; annelids, 7.2; bivalve mollusks, 1.6; insect larvæ, 0.4; débris, 16.4. Parasites: Distomes, 0.6; Acanthocephala, 1 in one fish; nematodes, 0.6; Sporozoa, 1 cyst on intestine of one fish and a few scattering cysts on the intestine of another.

STATION 12. LAGOON POND, VINEYARD HAVEN, JULY 17, 1916.

[Sandy bottom.]

Length, 25 to 50.—Maximum length, 50; minimum, 30; average, 43.1. Number examined, 10. Food: Amphipods, 18.8; annelids, 49.2; copepods, 0.1; insect larvæ, 0.1; débris, 31.9. Parasites: Distomes in each fish, maximum, 400 (approximate); minimum, 2; average, 70.7.

Length, 51 to 75.—Maximum length, 56; minimum, 54; average, 55. Number examined, 4. Food: Amphipods, 14.3; annelids, 51.3; insect larvæ, 0.2; ostracodes, trace; débris, 34.2. Parasites: Distomes in each, average, 39.2.

STATION 13. HEAD OF GREAT HARBOR, JULY 20, 1916.

[Bottom, sand and eelgrass.]

Length under 25.—Maximum length, 24; minimum, 22. Number examined, 2. Food: Amphipods, 5; annelids, 40; copepods, 12.5; larval Crustacea, 7.5; ostracodes, trace; débris, 35. Parasites: Distomes, 25.

Length, 25 to 50.—Maximum length, 42; minimum, 26; average, 33.1. Number examined, 9. Food: Amphipods, 45; annelids, 8.3; copepods, 9.6; gastropod mollusks, trace; ostracodes, 0.1; débris, 36.9. Parasites: Distomes in each fish, 38.3.

Length, 51 to 75.—Maximum length, 59; minimum, 58. Number examined, 3. Food: Amphipods, 13.3; annelids, 50; young fish (80 per cent in one fish), 26.6; débris, 10. Parasites: Distomes in each, 93.3.

STATION 14. HEAD OF GREAT HARBOR, JULY 22, 1915.

[Sandy bottom.]

Length, 25 to 50.—Maximum length, 50; minimum, 45; average, 47.6. Number examined, 3. Food: Amphipods, 15; annelids, 61.6; copepods, 0.3; isopods, 1; ostracodes, 0.3; débris, 21.6. Parasites: Distomes, 2.3.

Length, 51 to 75.—Maximum length, 75; minimum, 51; average, 63.5. Number examined, 17. Food: Amphipods, 12; annelids, 72; copepods, 0.1; insect larvæ, trace; isopods, 0.6; ostracodes, 1.3; univalve mollusks, 0.1; débris, 14. Parasites: Distomes, 6.2; nematodes, 1, in one fish.

Length, 101 to 125.—Length, 120. Number examined, 1. Food: Amphipods, 20; annelids, 30; ostracodes, 5; univalve mollusks, 20; débris, 25.

STATION 15. GREAT POND, EAST PALMOUTH, JULY 22, 1915.

[Low tide, 1 to 2 feet of water; bottom, sand and mud with clams; seining done along edge of eelgrass half-way up the pond; water clear, 78° F.; flounders, abundant.]

Length, 51 to 75.—Maximum length, 72; minimum, 52; average, 66. Number examined, 9. Food: Amphipods, 20; annelids, 50; Cumacea, trace; isopods, 6.6; débris, 23.4. Parasites: Distomes in each fish, average, 22.6.

Length, 76 to 100.—Maximum length, 96; minimum, 78; average, 88.2. Number examined, 4. Food: Amphipods, 15; annelids, 51.2; isopods, 20; débris, 13.8. Parasites: Distomes in each fish, average, 16.2.

Length, 101 to 125.—Maximum length, 125; minimum, 105; average, 115. Number examined, 3. Food: Amphipods, 18.3; annelids, 58.3; isopods, 3; ostracodes, 0.3; débris, 20. Parasites: Distomes in each fish, average, 12.6; Sporozoa, cysts in intestinal wall of one fish (length, 125 mm.).

Length, 126 to 150.—Length of each, 135. Number examined, 2. Food: Amphipods, 5; annelids, 87.5; clams, 6.2; débris, 1.2. Parasites: Distomes in each fish, average, 1.5; Sporozoa, numerous cysts in intestinal walls of one fish.

Length, 151 to 175.—Maximum length, 175; minimum, 155; average, 168.3. Number examined, 3. Food: Annelids, 65; clams, 16.6; débris, 18.3. Parasites: Distomes in each fish, average, 15.3; Sporozoa, cysts very numerous in intestinal wall of one fish.

STATION 16. EEL POND, JULY 25, 1916.

[Bottom, eelgrass and mud.]

Length, 51 to 75.—Maximum length, 72; minimum, 58; average, 59.8. Number examined, 5. Food: Amphipods, 51.2; annelids, 1; Cumacea, 13; débris, 34.8. Parasites: Distomes, 2; nematodes, one small *Filaria* in one fish.

STATION 17. CUTTYHUNK, JULY 26, 1916.

[Bottom, sand and eelgrass.]

Length, 26 to 50.—Maximum length, 50; minimum, 36; average, 43.7. Number examined, 7. Food: Amphipods, 38.5; annelids, 22.8; copepods, 5.3; ostracodes, 0.8; débris, 32.4. Parasites: Distomes, 6.5.

Length, 51 to 75.—Maximum length, 75; minimum, 52. Number examined, 2. Food: Amphipods, 56; annelids, 25; insect larvæ, trace; débris, 24. Parasites: Distomes, 23; nematodes, 2.5. The débris consisted of annelid and crustacean fragments, and diatoms; the latter were interpreted as having been introduced with the amphipods.

STATION 18. NAUSHON, BUZZARDS BAY SHORE, JULY 26, 1916.

[Bottom, sand and eelgrass.]

Length, 26 to 50.—Maximum length, 40; minimum, 37. Number examined, 2. Food: Amphipods, 35; annelids, 20; copepods, trace; débris, 45. Parasites: Distomes, 6.5.

Length, 51 to 75.—Maximum length, 65; minimum, 52; average, 55.6. Number examined, 6. Food: Amphipods, 77.1; annelids, 15; copepods, trace; insect larvæ, 0.1; ostracodes, trace; débris, 7.6. Parasites: Distomes, 10.8; nematodes, 0.5; Sporozoa, 1 cyst on serous membrane, between stomach and liver of one fish.

STATION 19. KATAMA BAY, MARTHAS VINEYARD, JULY 27, 1915.

[Bottom, sand, with much algae. The bay had been closed on the ocean side for the preceding six years. There is, therefore, but little current produced by the tides. Flounders, few.]

Length, 26 to 50.—Maximum length, 49; minimum, 28; average, 38.5. Number examined, 12. Food: Amphipods, 32.7; annelids, 11.8; Cumacea, 1.8; copepods, 26.3; coelenterates (*Sagartia*), 0.5; univalve mollusk (*Crepidula*), 1.3; larval Crustacea, 1.8; nemerteans, 0.5; ostracodes, 4; débris, 19.1. Parasites: Distomes, maximum, 317; minimum, 3; average, 99.7; Sporozoa, 1 cyst on intestine of smallest fish. In one fish (32 mm. in length), the alimentary canal was empty except for the presence of distomes, of which there were 317 in the stomach.

Length, 51 to 75.—Maximum length, 58; minimum, 52. Number examined, 2. Food: Amphipods, 90; mollusks (*Crepidula*), 10.

Length, 101 to 125.—Maximum length, 125; minimum, 115; average, 120. Number examined, 5. Food: Amphipods, 48; annelids, 28; crabs, 5.2; *Limulus*, 3; mollusks (*Crepidula*), 3.6; débris, 12. Parasites: Sporozoa, a few cysts on the intestines of three fish.

Length, 126 to 150.—Maximum length, 150; minimum, 130; average, 138. Number examined, 5. Food: Amphipods, 34.2; annelids, 35.6; bivalve mollusks, 10; crabs, 7.4; *Limulus*, 0.6; ostracodes, trace; shrimp, 0.9; univalve mollusks, 4.6; débris, 7.6. Parasites: Distomes, 1.2.

Length, 176 to 200.—Length, 190. Number examined, 1. Food: Amphipods, 5; annelids, 75; clams, 15; débris, 5. Parasites: Distomes, 2.

STATION 20. KATAMA BAY, JULY 28, 1916.

[Bottom, sand and gravel.]

Length, 26 to 50.—Length, 45. Number examined, 1. Food: Amphipods, 65; annelids, 15; copepods, 5; débris, 15. Parasites: Distomes, 50.

Length, 51 to 75.—Maximum length, 74; minimum, 52; average, 63.2. Number examined, 13. Food: Amphipods 65; annelids, 11.2; bivalve mollusks, 0.1; copepods, 0.1; isopods, 0.1; ostracodes, 0.1; débris, 23.4. Parasites: Distomes in each fish, average 20.1; Sporozoa, 1 cyst, 2 mm. in diameter, on intestine of one fish (61 mm.).

STATION 21. MONUMENT BEACH, AUGUST 1, 1916.

[Bottom, sand and eelgrass.]

Length, 25 to 50.—Maximum length, 50; minimum, 35; average, 41.8. Number examined, 5. Food: Amphipods, 40.6; annelids, 26; copepods, 4.8; Cumacea, 1; débris, 27.6. Parasites: Distomes, 3.4.

Length, 51 to 75.—Maximum length, 75; minimum, 52; average, 60.3. Number examined, 6. Food: Amphipods, 14.1; annelids, 48.3; débris, 37.5. Parasites: Distomes, 1.1; Sporozoa, 1 cyst, 2 mm. in diameter, on intestine of one fish (59 mm.).

Length, 76 to 100.—Length, 80. Number examined, 1. Food: Amphipods, 50; crabs, 2; isopods, 12; shrimp, 2; débris, 34. Parasites: Nematodes, 2.

STATION 22. MENEMSHA POND, AUGUST 2, 1916.

[Bottom, sand and eelgrass.]

Length, 26 to 50.—Maximum length, 50; minimum, 43; average, 47.2. Number examined, 5. Food: Amphipods, 32.4; annelids, 38; copepods, trace; débris, 29.6. Parasites: Distomes, 4.6.

Length, 51 to 75.—Maximum length, 74; minimum, 57; average, 65.5. Number examined, 7. Food: Amphipods, 6.7; annelids, 58; débris, 35.2. Parasites: Distomes, 1.8.

STATION 23. MENEMSHA, INSIDE BREAKWATER, AUGUST 2, 1915.

[Bottom, sand and pebbles.]

Length, 25 to 50.—Maximum length, 42; minimum, 35. Number examined, 2. Food: Amphipods, 17.5; ostracodes, 20; débris, 62.5. Parasites: Distomes, 24.5.

Length, 101 to 125.—Length, 110. Number examined, 1. Food: Amphipods, 3; isopods, 2; shrimp, 75; débris, 20.

Length, 126 to 150.—Maximum length, 140; minimum, 127; average, 130.2. Number examined, 4. Food: Amphipods, 27.5; annelids, 10; isopods, trace; mollusks (siphons of clams), 7.5; shrimp, 47.5; débris, 7.5.

STATION 24. MOUTH OF TRURO HARBOR, CAPE COD BAY, AUGUST 8, 1916.

[Bottom, sandy.]

Length, 25 to 50.—Maximum length, 50; minimum, 44; average, 46.7. Number examined, 4. Food: Amphipods, 1; annelids, 80; insect larvæ, 0.5; débris, 18.5.

Length, 51 to 75.—Maximum length, 62; minimum, 60. Number examined, 2. Food: Annelids, 82.5; débris, 17.5. The indigestible residue in this lot of fish, as in all cases where annelids form the bulk of the food, is sand, and has doubtless been introduced with the annelids.

STATION 25. MENEMSHA, AUGUST 10, 1915.

[Inside harbor, on grassy and gravelly bottom.]

Length, 51 to 75.—Length, 70. Number examined, 1. Food: Amphipods, 50; annelids, 25; débris, 25.

Length, 101 to 125.—Maximum length, 125; minimum, 115. Number examined, 2. Food: Amphipods, 25; annelids, 72.5; débris, 2.5. Parasites: Sporozoa, many cysts on intestine of smaller fish.

Length, 126 to 150.—Maximum length, 150; minimum 130; average, 140. Number examined, 4. Food: Amphipods, 21.5; annelids, 71.2; bivalve mollusks, 0.1; fish, 0.5; isopods, 0.3; débris, 6.6. Parasites: Distomes, 50.

Length, 151 to 175.—Maximum length, 175; minimum, 153; average, 161.2. Number examined, 4. Food: Amphipods, 1.6; annelids, 95; bivalve mollusks, 0.3; univalve mollusks, 0.1; débris, 3. Parasites: Distomes, 45; Sporozoa, 1 cyst on intestine of fish measuring 153 mm.

STATION 26. LACKEY'S BAY, AUGUST 3, 1915.

[Muddy bottom, fish collected at high tide.]

Length, 51 to 75.—Maximum length, 74; minimum, 55; average, 64.8. Number examined, 6. Food: Amphipods, 13.1; annelids, 27.3; copepods, 0.1; insect larvæ, 2.5; ostracodes, 0.1; débris, 56.6 (consisting of a little vegetable material and sand). Parasites: Distomes, 3.8.

Length, 76 to 100.—Maximum length, 100; minimum, 76; average, 83.5. Number examined, 4. Food: Amphipods, 31.2; annelids, 57.5; insect larvæ, 3.4; ostracodes, 0.9; débris, 6.7. Parasites: Distomes, 3.2; Sporozoa, many cysts on lower part of intestine of fish 100 mm. in length.

Length, 101 to 125.—Maximum length, 122; minimum, 115; average, 119. Number examined, 3. Food: Amphipods, 15; annelids, 5; bivalve mollusks, 0.3; ostracodes, trace; univalve mollusks, 0.3; débris (some vegetable material), 79.3. Parasites: Nematodes, 0.3; large numbers of cysts of Sporozoa on intestine of fish measuring 120 mm.

Length, 126 to 150.—Maximum length, 142; minimum, 126; average, 136. Number examined, 4. Food: Amphipods, 8.5; annelids, 25.2; bivalve mollusks (young *Mya* and *Solenomya*), 5; ostracodes, 0.2; débris (a little vegetable material, with fragments of amphipods, setæ of annelids, and sand), 61. Parasites: Distomes, 1.5; nematodes, 1.

STATION 27. EEL POND, SEPTEMBER 2, 1915.

[Bottom, eelgrass and mud.]

Length, 51 to 75.—Length, 62. Number examined, 1. Food: Amphipods, 95; ostracodes, trace; débris, 5. Parasites: Nematodes, 2 small *Filaria* and 1 immature *Ascaris*.

Length, 126 to 150.—Maximum length, 142; minimum, 130; average, 138. Number examined, 3. Amphipods, 95; bivalve mollusks, 0.3; ostracodes, 0.3; débris (trace of vegetable material), 4.3.

Length, 151 to 175.—Maximum length, 172; minimum, 154; average, 144.6. Number examined, 6. Food: Amphipods, 48.3; annelids, 7; bivalve mollusks (*Venus*, small), 5; Cumacea, trace; ostracodes, trace; univalve mollusks (*Bulla*, etc.), 4.1; débris, 35.6. Parasites: Nematodes (*Filaria*), 4.3; many cysts on rectum of one fish (150 mm.), a few cysts on mesentery of another (172 mm.).

Length, 176 to 200.—Maximum length, 192; minimum, 182. Number examined, 2. Food: Amphipods, 27.5; annelids, 25; univalve mollusks (*Bulla*), 5; débris, 42.5.

Length, 201 to 225.—Maximum length, 225; minimum, 212. Number examined, 2. Food: Amphipods, 5; annelids, 5; bivalve mollusks, 1; univalve mollusks (*Bulla*), 42.5; débris (some vegetable material), 46.5. Parasites: Nematodes, 1 (*Filaria*).

STATION 28. SHEEP-PEN COVE, SEPTEMBER 9, 1915.

[Bottom, mud and sand; high tide; depth, 3 feet; temperature of water, 67° F.]

Length, 51 to 75.—Maximum length, 73; minimum, 58; average, 66. Number examined, 4. Food: Amphipods, 50; annelids, 33.7; débris, 16. Parasites: Distomes, 4.7.

Length, 76 to 100.—Maximum length, 90; minimum, 85. Number examined, 2. Food: Amphipods, 75; annelids, 20; débris, 5. Parasites: Distomes, 10.

Length, 101 to 125.—Length, 104. Number examined, 1. Food: Amphipods, 2; annelids, 88; débris, 10. Parasites: Distomes, 2.

Length, 126 to 150.—Length, 132. Number examined, 1. Food: Amphipods, 1; annelids, 95; débris, 4.

STATION 29. MENEMSHA BIGHT, SEPTEMBER 10, 1915.

[Sandy bottom with eelgrass; depth of water, 6 feet; temperature, 68° F.]

Length, 51 to 75.—Length, 70. Number examined, 1. Food: Amphipods, 4; annelids, 48; débris, 48. Parasites: Distomes, 5; nematodes (*Filaria*), 2.

Length, 126 to 150.—Maximum length, 150; minimum, 140. Number examined, 2. Food: Amphipods, trace; annelids, 50; bivalve mollusks, 2.5; débris, 47.5. Parasites: Distomes, 1; *Acanthocephala*, 1 in one fish.

Length, 151 to 175.—Maximum length, 162; minimum, 152; average, 156.3. Number examined, 3. Food: Amphipods, 9; annelids, 26.3; bivalve mollusks (broken shells, probably introduced with annelids), 3.3; shrimp, 10.6; débris, 50.6. Parasites: Distomes, 2; nematodes, 1 small *Filaria* in one fish.

STATION 30. GREAT HARBOR, SEPTEMBER 14, 1915

[Sandy bottom.]

Length, 51 to 75.—Maximum length, 72; minimum, 62; average, 66.5. Number examined, 4. Food: Amphipods, 69.5; annelids, 10; ostracodes, trace; débris (sand, with annelid setæ), 19.5. Parasites: Distomes, 1.5; sporocysts, few, 0.5 mm. in diameter, on intestine of one fish.

Length, 76 to 100.—Maximum length, 96; minimum, 84; average, 88.3. Number examined, 3. Food: Amphipods, 14.3; annelids, 69.6; Cumacea, 1.3; débris (some red alga in one fish), 14.6. Parasites: Distomes, 1.

Length, 126 to 150.—Length, 128. Number examined, 1. Food: Amphipods, 15; débris (sand, with annelid setæ, alimentary canal nearly empty), 85. Parasites: Sporozoa, large numbers of cysts, 1 mm. and less in diameter, on intestine.

STATION 31. EEL POND, SEPTEMBER 18, 1915.

[Bottom, mud and eelgrass; temperature of water, 70° F.]

Length, 51 to 75.—Length each, 70. Number examined, 3. Food: Amphipods, 91.7; annelids, 8.3. Parasites: Distomes, 1 in one fish; nematodes, 1 in one fish; Sporozoa, wall of intestine of one fish thickly beset with small cysts, 0.4 mm., more or less, in diameter, and 1 cyst, 2 mm. in diameter, on intestine of another.

Length, 76 to 100.—Maximum length, 90; minimum, 87; average, 98. Number examined, 3. Food: Amphipods, 97.6; bivalve mollusks, 0.3; ostracodes, 2. Parasites: Distomes, 2.

STATION 32. EEL POND, OCTOBER 18, 1915.

[Muddy bottom; temperature of water, 55° F.]

Length, 101 to 125.—Length, 104. Number examined, 1. Food: Amphipods, 80; annelids, trace; bivalve mollusks, trace; ostracodes, trace; débris, 20. Parasites: Nematodes, 1 (*Filaria*).

Length, 126 to 150.—Maximum length, 150; minimum, 130; average, 136.6. Number examined, 3. Food: Amphipods, 53.3; annelids, 3.3; bivalve mollusks, 0.3; ostracodes, 0.3; débris (some vegetable material, scales and bits of muscle tissue of fish, and crustacean fragments), 42.6. Parasites: Nematodes, 1 (*Filaria*) in one fish; Sporozoa, large numbers of cysts on intestine of each fish, 1 mm. and less in diameter. The alimentary canal of one fish, 150 mm. in length, was nearly empty; the tissue of the intestinal wall was almost completely replaced by cysts. In each case the cysts were closely crowded together and the intestine was easily broken.

Length, 151 to 175.—Maximum length, 158; minimum, 153. Number examined, 2. Food: Amphipods, 12.5; annelids, 30; ostracodes, trace; débris, 57.5.

STATION 33. QUISSET HARBOR, OCTOBER 19, 1915.

[Muddy bottom; temperature of water, 55° F.]

Length, 76 to 100.—Maximum length, 96; minimum, 82; average, 88.6. Number examined, 3. Food: Amphipods, 16.6; annelids, 11.6; shrimp, 30; débris (contents of intestines of annelids), 41.6. Parasites: Sporozoa, a few cysts, 2 mm. in diameter and less, on intestine of smallest fish.

Length, 101 to 125.—Maximum length, 124; minimum, 110; average, 116. Number examined, 9. Food: Amphipods, 2.9; annelids, 32.4; bivalve mollusks, 0.8; isopods, 0.1; shrimp, 24; univalve mollusks (Bulla), 12.1; débris (largely from annelids), 27.6. Parasites: Distomes, 0.2; nematodes (Filaria), 1.

STATION 34. QUISSET HARBOR, OCTOBER 22, 1915.

[Sandy bottom; temperature of water, 55° F.]

Length, 51 to 75.—Length, 62. Number examined, 1. Food: Amphipods, .2; débris, 98.

Length, 76 to 100.—Maximum length, 98; minimum, 80; average, 90.2. Number examined, 4. Food: Amphipods, 21.5; annelids, 43.5; bivalve mollusks, 0.5; débris, 34.5. Parasites: Distomes, 2 in one fish (98 mm.); nematodes, 1 (Filaria) in one fish (80 mm.).

Length, 101 to 125.—Length, 110. Number examined, 1. Food: Amphipods, 2; annelids, 68; débris, 30.

STATION 35. BUZZARDS BAY SHORE, NEAR WOODS HOLE, OCTOBER 26, 1915.

[Bottom, white sand; temperature of water, 55° F.]

Length, 51 to 75.—Maximum length, 74; minimum, 54; average, 63.6. Number examined, 5. Food: Amphipods, 10.2; annelids, 60; débris (sand with algæ, and annelid setæ), 29.8. Parasites: Distomes, 1.4.

Length, 76 to 100.—Maximum length, 96; minimum, 78; average, 84. Number examined, 3. Food: Amphipods, 1.6; annelids, 43.3; shrimp, 13.3; débris (sand, algæ, and annelid setæ), 41.6. Parasites: Distomes, 4.6; Sporozoa, numerous cysts, 1.5 mm. and less in diameter, on intestine of one fish.

STATION 36. EEL POND, NOVEMBER 2, 1915.

[Muddy bottom.]

Length, 76 to 100.—Maximum length, 100; minimum, 78; average, 90.2. Number examined, 5. Food: Amphipods, 76; annelids, 9; isopods, 5; ostracodes, 0.4; débris, 9.6. Parasites: Distomes, 0.6; nematodes, 0.4; Sporozoa, 1 cyst, 3.5 mm. in diameter, on intestine of one fish (100 mm.), numerous cysts, 1 mm. or less in diameter, clustered on lower half of intestine of one fish (92 mm.). In a fish measuring 86 mm. the intestine was densely covered and its walls filled with cysts 1 mm. or less in diameter. The intestine was easily broken in the formalin specimen. The alimentary canal was nearly empty. The same condition was noted under station 32.

FOOD AND PARASITES OF 398 SMALL WINTER FLOUNDERS DISTRIBUTED ACCORDING TO SIZE OF FISH, NUMBER OF FISH, AND NUMBER OF STATIONS.

[Figures referring to food represent average per cent of volume; figures referring to parasites represent numerical average except under Sporozoa, where they indicate the number of fish in which cysts were found.]

| | Num-ber. | Average length in millimeters. | Fish. | Crabs. | Shrimp. | Lar-val crustacea. | Amphi-pods. | Iso-pods. | Cuma-cea. | Ostra-codes. | Cope-pods. | Insect larvæ. |
|-------------------------------|----------|--------------------------------|-------|--------|---------|--------------------|-------------|-----------|-----------|--------------|------------|---------------|
| Size of fish, in millimeters: | | | | | | | | | | | | |
| Under 25..... | 8 | 22.9 | ..... | ..... | ..... | 1.8 | 6.1 | ..... | ..... | 0.6 | 50.9 | 0.3 |
| 25 to 50..... | 142 | 36.4 | ..... | ..... | 0.05 | .14 | 38 | 0.15 | 0.25 | 1.1 | 11 | .04 |
| 51 to 75..... | 113 | 61.8 | 0.7 | ..... | ..... | ..... | 38 | .61 | .79 | .23 | .23 | .21 |
| 76 to 100..... | 35 | 88.4 | ..... | 0.02 | 6.34 | ..... | 37.2 | 3.3 | .13 | .31 | (1) | .38 |
| 101 to 125..... | 45 | 114.1 | ..... | .6 | 6.4 | ..... | 33.9 | .66 | (1) | .13 | ..... | .31 |
| 126 to 150..... | 30 | 136.6 | .07 | 1.27 | 6.38 | ..... | 26.6 | (1) | ..... | .08 | ..... | ..... |
| 151 to 175..... | 19 | 161.6 | ..... | ..... | 1.7 | ..... | 18.3 | ..... | ..... | (1) | ..... | ..... |
| 176 to 200..... | 4 | 186 | ..... | ..... | ..... | ..... | 15 | ..... | ..... | ..... | ..... | ..... |
| 201 to 225..... | 2 | 218.5 | ..... | ..... | ..... | ..... | 5 | ..... | ..... | ..... | ..... | ..... |
| Number of fish..... | ..... | ..... | 2 | 8 | 16 | 4 | 329 | 30 | 19 | 80 | 99 | 27 |
| Number of stations..... | ..... | ..... | 2 | 2 | 8 | 3 | 35 | 11 | 11 | 19 | 16 | 10 |

| | Num-ber. | Average length in millimeters. | Lim-ulus. | Bi-valve mol-lusks. | Uni-valve mol-lusks. | Anne-lids. | Nem-er-teans. | Cœ-len-ter-ata. | Dœ-bris. | Spo-rozoa. | Trem-atodes. | Nema-todes. | Acan-tho-ceph-ala. |
|-------------------------------|----------|--------------------------------|-----------|---------------------|----------------------|------------|---------------|-----------------|----------|------------|--------------|-------------|--------------------|
| Size of fish, in millimeters: | | | | | | | | | | | | | |
| Under 25..... | 8 | 22.9 | ..... | ..... | 10.7 | ..... | ..... | 30.1 | ..... | 7.7 | ..... | 0.2 | ..... |
| 25 to 50..... | 142 | 36.4 | ..... | ..... | 1.0 | 18.85 | 0.03 | 0.03 | 29.1 | 2 | 30.9 | ..... | ..... |
| 51 to 75..... | 113 | 61.8 | (1) | .2 | 34.6 | ..... | ..... | 33.37 | ..... | 7 | 11.4 | .21 | ..... |
| 76 to 100..... | 35 | 88.4 | ..... | 0.05 | 34.2 | ..... | ..... | 17.4 | ..... | 6 | 3.8 | .2 | ..... |
| 101 to 125..... | 45 | 114.1 | 0.33 | .38 | 3.40 | 29.9 | ..... | 25.4 | ..... | 12 | 1.02 | .34 | 0.02 |
| 126 to 150..... | 30 | 136.6 | .08 | 4.11 | .8 | 35.1 | ..... | 24.6 | ..... | 7 | 9.2 | .03 | .03 |
| 151 to 175..... | 19 | 161.6 | ..... | 4.8 | 1.34 | 39.7 | ..... | 28.7 | ..... | 3 | 12.3 | 1.4 | .05 |
| 176 to 200..... | 4 | 186 | ..... | ..... | 6.25 | 31.2 | ..... | 47.5 | ..... | 1 | ..... | ..... | ..... |
| 201 to 225..... | 2 | 218.5 | ..... | 1 | 32.5 | 5 | ..... | 46.5 | ..... | ..... | ..... | ..... | ..... |
| Number of fish..... | ..... | ..... | 3 | 27 | 34 | 241 | 1 | 1 | 360 | 38 | 246 | 32 | 3 |
| Number of sta-tions..... | ..... | ..... | 1 | 14 | 9 | 34 | 1 | 1 | 35 | 19 | 19 | 14 | 3 |

¹ Traco.

It will be seen from the table that small winter flounders feed principally upon amphipods and other small Crustacea, and upon annelids. At the same time they are not restricted to Crustacea and annelids but evidently can utilize a variety of alternative material.

The habits of the flounder—as one may observe its behavior in an aquarium which is provided with sufficient sand—while strictly those of a bottom fish (so far, at least, as its position is concerned) are in reality those of an active and predatory fish. The food to which it will most readily react must be in the shape of objects which are in motion. Although it is by no means a swift swimmer it is capable of very quick movements within a limited range. In its favorite position it lies flat on the bottom, often partly covered with sand. When not concealed by a covering of sand, it quickly assumes a color and marking which cause it to blend indistinguishably with its surroundings. From this natural ambush it makes sudden dashes—with surprising quickness—upon objects which move

near it. Thus it is easily explained why it is that the principal food of this bottom fish is not such objects as would be obtained by rooting or grubbing in the sand and mud, but crustaceans and annelids, the capture of which requires considerable agility.

The presence of the siphons of pelecypod mollusks, which are occasionally found in the stomachs of flounders, is accounted for when it is recalled that flounders often bite off the extended siphons of mollusks. The appearance of such siphons as I have found in the stomachs of flounders would indicate this origin rather than that they represent the least digestible parts of the mollusk.

Vinal Edwards's record shows that 628 adult winter flounders were examined on 82 dates. The following data from his unpublished food notes are appended: Annelids are recorded on 9 dates, in 50 fish; Crustacea, on 10 dates, in 67 fish; ascidians, on 26 dates, in 126 fish; and mollusks, on 11 days, in 56 fish. The ascidian which Mr. Edwards records is *Botryllus gouldii*, which occurs abundantly on eelgrass, where it forms translucent, fleshy incrustations. The small flounders which the author has examined did not contain any tunicate material.

An increase in the ratio of annelids to Crustacea with the size of the fish is observable in fishes under 200 mm. in length. Thus the percentages are: In 150 fish, 50 mm. and under, Crustacea 51.45, annelids 18.10; in 148 fish, 51 to 100 mm. in length, Crustacea 41.21, annelids 34.47; in 75 fish, 101 to 150 mm. in length, Crustacea 34.74, annelids 32.10; in 23 fish, 151 to 200 mm. in length, Crustacea 14.17, annelids 36.91.



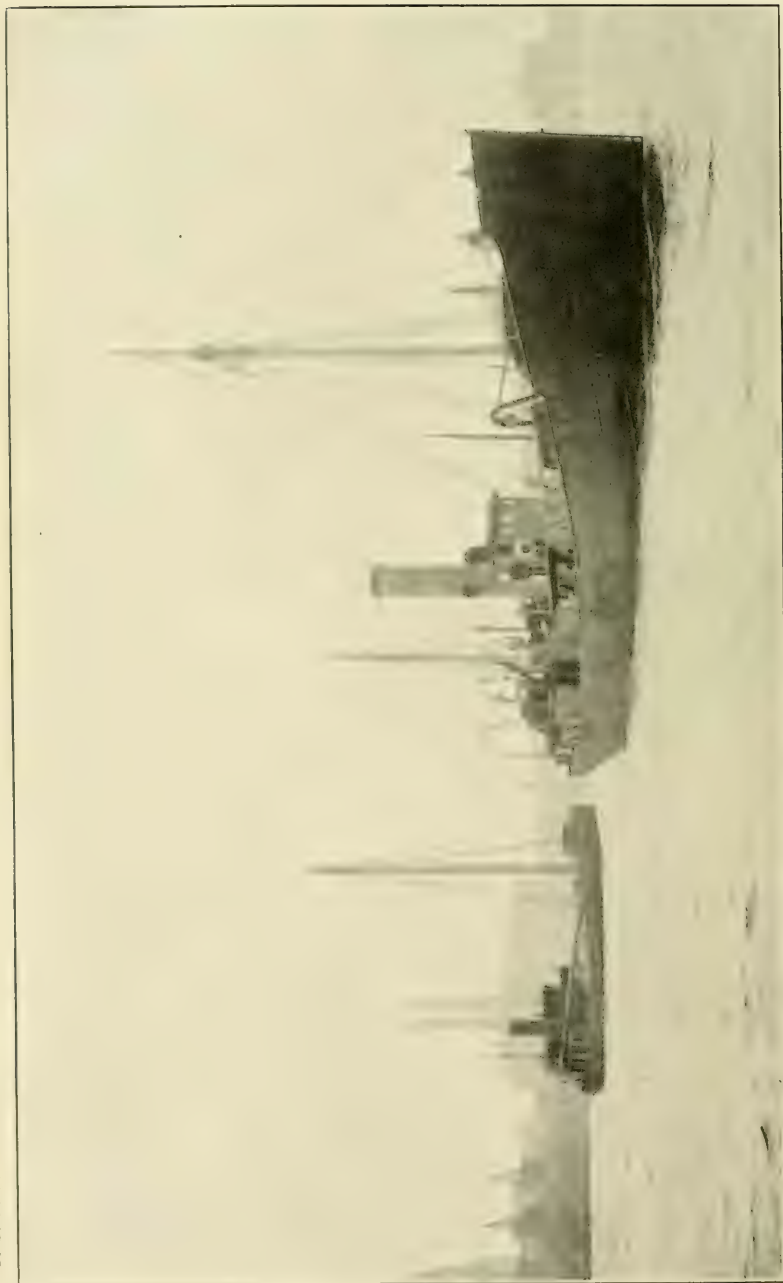


FIG. 1.—NEW ENGLAND STEAM TRAWLER.

FISHERY INDUSTRIES OF THE UNITED STATES.

REPORT OF THE DIVISION OF STATISTICS AND METHODS OF THE FISHERIES FOR 1920.¹

By LEWIS RADCLIFFE, *Assistant in Charge.*

CONTENTS.

| | Page. |
|--|-------|
| Introduction..... | 5 |
| Summary of operations..... | 5 |
| Service..... | 6 |
| Aid in improving fishing operations..... | 7 |
| Fishery intelligence service..... | 7 |
| Use of aircraft..... | 7 |
| New England fishery intelligence service..... | 9 |
| Notes on fishing gear..... | 9 |
| Paranzella net..... | 9 |
| Lampara net..... | 12 |
| Herring gill net..... | 14 |
| Smelt net..... | 14 |
| Trammel net..... | 14 |
| Development of improvements in methods of handling, distributing, and marketing..... | 15 |
| Fresh fish..... | 15 |
| Kippered fish..... | 15 |
| Increasing the use of fish as food..... | 16 |
| The haddock..... | 16 |
| Frozen fish..... | 17 |
| Technological investigations..... | 17 |
| Salting river herring..... | 17 |
| Refrigeration of fish..... | 18 |
| Canning of Pacific coast fishes..... | 18 |
| Preservation of fish nets..... | 19 |
| Increasing the use of by-products of fisheries..... | 19 |
| Fish oils..... | 19 |
| Fish scrap and meal..... | 20 |
| Fish leather..... | 20 |
| Shark fins..... | 21 |
| Pearl essence or fish-scale essence..... | 21 |
| New England vessel fisheries..... | 22 |
| General statistics..... | 22 |
| Species..... | 42 |
| Cod..... | 42 |
| Haddock..... | 43 |
| Hake..... | 43 |
| Pollock..... | 43 |
| Cusk..... | 43 |
| Halibut..... | 43 |
| Mackerel..... | 44 |
| Swordfish..... | 44 |
| Flounders..... | 44 |
| Herring..... | 45 |
| Vessel fisheries at Seattle, Wash..... | 45 |
| Fishery products received at Municipal Fish Wharf and Market, Washington, D. C..... | 49 |

¹ Appendix X to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 908.

| | Page. |
|--|-------|
| Shad fishery of the Hudson River..... | 51 |
| Shad and alewife fishery of the Potomac River..... | 51 |
| Fish, frozen..... | 52 |
| Cold-storage holdings during 1920..... | 52 |
| Quantities frozen during 1920..... | 53 |
| Fisheries of California in 1920..... | 54 |
| Common and scientific names of fishes..... | 55 |
| Products..... | 56 |
| Fisheries of the South Atlantic States in 1918..... | 59 |
| Earlier publications..... | 60 |
| Common and scientific names of fishes..... | 60 |
| General statistics..... | 61 |
| Fisheries of North Carolina..... | 70 |
| Fisheries by counties..... | 72 |
| Fisheries by apparatus..... | 80 |
| Industries..... | 91 |
| Menhaden industry..... | 91 |
| Wholesale trade..... | 91 |
| Canning industry..... | 91 |
| Fisheries of South Carolina..... | 92 |
| Fisheries by counties..... | 93 |
| Fisheries by apparatus..... | 95 |
| Industries..... | 97 |
| Wholesale trade..... | 97 |
| Oyster-canning industry..... | 97 |
| Fisheries of Georgia..... | 98 |
| Fisheries by counties..... | 99 |
| Fisheries by apparatus..... | 102 |
| Industries..... | 104 |
| Wholesale trade..... | 104 |
| Canning industry..... | 104 |
| Fisheries of east coast of Florida..... | 105 |
| Fisheries by counties..... | 105 |
| Fisheries by apparatus..... | 109 |
| Industries..... | 114 |
| Menhaden industry..... | 114 |
| Wholesale trade..... | 115 |
| Canning industry..... | 115 |
| Summary of the fisheries of Florida in 1918..... | 115 |
| Sponge fishery of Florida..... | 117 |
| Summaries of the fisheries of the Gulf States for various years..... | 119 |
| Fisheries of the New England States in 1919..... | 120 |
| Earlier publications..... | 120 |
| Common and scientific names of fishes..... | 121 |
| General statistics..... | 122 |
| By-products..... | 131 |
| Fisheries of Maine..... | 132 |
| Fisheries by counties..... | 132 |
| Fisheries by apparatus..... | 137 |
| Salmon fishery of Penobscot River and Bay..... | 145 |
| Humpback salmon..... | 147 |
| Industries..... | 147 |
| Wholesale fishery trade..... | 147 |
| Smoked-fish industry..... | 148 |
| Canning industry..... | 148 |
| Sardine industry in 1919 and 1920..... | 150 |
| Fisheries of New Hampshire..... | 152 |
| Fisheries of Rockingham County..... | 153 |
| Fisheries by apparatus..... | 153 |
| Wholesale fishery trade..... | 154 |
| Fisheries of Massachusetts..... | 154 |
| Fisheries by counties..... | 155 |
| Fisheries by apparatus..... | 160 |
| Industries..... | 171 |
| Wholesale fishery trade..... | 171 |
| Smoked, canned, and by-product industries..... | 171 |

| | |
|--|-------|
| Fisheries of the New England States in 1919—Continued. | Page. |
| Fisheries of Rhode Island..... | 172 |
| Fisheries by counties..... | 174 |
| Fisheries by apparatus..... | 176 |
| Wholesale fishery trade..... | 180 |
| Fisheries of Connecticut..... | 181 |
| Fisheries by counties..... | 181 |
| Fisheries by apparatus..... | 184 |
| Wholesale fishery trade and menhaden industry..... | 187 |

INTRODUCTION.

During the period of the war the production and consumption of fishery products were stimulated, receiving much encouragement from governmental and other agencies as a war measure. This resulted in making provision for a considerable expansion of facilities for the capture, preservation, and marketing of fishery products, the fulfillment of which extended into the postwar period. In this readjustment period a heavy decline in the consumption of fish not only in the United States but in other countries has been apparent. Added to this advancing prices of labor and materials, curtailment in export trade, and other factors, such as labor difficulties, produced in some respects one of the most difficult and threatening situations in the history of the industry. Even in 1919, while provisions for greater production were being fulfilled, the effects of these conditions were felt and the curtailment in production in certain of our important fisheries as compared with the previous year was quite marked. For example, many of the large New England trawlers were tied up for lack of markets. The catch of the vessel fisheries centering at Boston and Gloucester, Mass., and Portland, Me., in 1919 decreased more than 9,000,000 pounds as compared with 1918 and in 1920 there was a further decrease in excess of 16,000,000 pounds. The packs of salmon and sardines were materially curtailed in 1920, and increasing difficulty has been experienced in marketing such fish as groupers on the Gulf coast, considerable quantities being dumped for lack of markets.

These conditions have compelled a much closer, more serious study of the economic situation. As a result there has been an unusually heavy demand upon the Bureau for statistical and technological data, the conduct of investigations which promise improvement in practices and economies of operation, aid in stimulating the consumption of fish, and the extension of the use of fishery products in the arts and industries. Although the reduction in the division's appropriation for the fiscal year 1921 to \$7,500 has compelled the practical abandonment of technological research for the current fiscal year, an effort has been made to render the industry the fullest possible measure of service for its betterment and the benefit of the consuming public.

SUMMARY OF OPERATIONS.

For effecting improvements and economies in the methods of conducting the fisheries, arrangements were perfected by the Bureau for an extended trial of seaplanes to determine their commercial value as an adjunct to the fisheries, and a fishery intelligence service was initiated in New England for supplying information as to the presence of schooling fish in the vicinity of advantageously located

lightships and lighthouses. In addition, information regarding the construction and operation of lesser known fishing gear and methods has been obtained for the use of the fisheries. The need for improvements in the methods of handling, distributing, and marketing of fishery products has been felt, and improvements, such as the exercise of greater care in handling fish by eliminating the use of pitchforks, the avoidance of needless bruising of the fish, and the adoption of some form of precooling on the vessels, has been urged upon the producers. Much assistance has been given producers in the securing and transporting of materials such as salt, barrels, etc., which were required for immediate use in preserving fish in abundance.

In the field of fisheries technology practical application has been made of methods developed in the course of its fish-salting investigations, and studies have been made and reports prepared on the preservation of fish nets and methods of determining the fatness of certain fishes. The investigations of the problems of the commercial fish canner have been continued at San Pedro, Calif. The Bureau has continued its efforts to stimulate the saving of waste products of the fisheries and their conversion into marketable commodities with excellent success. The production of fish meal and fish leather, the saving of such articles as shark fins, and the utilization of fish scales have materially increased.

The statistical activities of the division have included the collection of detailed statistics of the vessel fisheries centering at Boston and Gloucester, Mass., Portland, Me., and Seattle, Wash., and the publication of the results in monthly and annual bulletins; and canvasses of the shad fishery of the Hudson River, of the shad and alewife fishery of the Potomac River, and of the Maine sardine industry, all for the calendar year 1920. A canvass of the fisheries of the New England States for the calendar year 1919 was undertaken and the field work completed about March 1, 1921. The results of these canvasses are contained in the present report, together with the detailed tables of the canvass of the fisheries of the South Atlantic States for 1918, a summary of the storage holdings of frozen fish during 1920, and the quantity of fishery products by species and by months for California in 1920. The report also contains statistical data on the production of fish oils, scrap, and meal, a summary of the fisheries of both coasts of Florida in 1918, a summary of the fisheries of the Gulf States for various years, certain sponge statistics, etc.

SERVICE.

Units of the Federal Government such as this division receive an appropriation for the rendering of service. It is usually difficult to ascertain on a monetary basis the value of the service rendered, and the organization is not infrequently criticized as not rendering service in proportion to the facilities supplied for its work or through misunderstanding of its limitations. It may therefore be of interest to refer to the appreciation expressed by competent persons of the value of several phases of its work.

Of the Bureau's new method of salting fish, a practical demonstration of which was given on the St. Johns River, Fla., one writer states:

We consider the information and the demonstration worth thousands of dollars to us alone, not saying what it is worth to the industry at large on the St. Johns River.

Regarding the introduction of fish meal production on the Atlantic seaboard, one writes:

We estimate that the work done by your force in behalf of fish meal increased the value of last season's fish products at this point considerably above \$100,000, and I am frank to say that were it not for this new market I do not think it would be possible for us to operate our plants this season, owing to the very unsettled conditions in the fertilizer trade.

Of the Bureau's paper on Preservation of Fish Nets, an authority in the net and twine trade states:

It was a surprise to find it had been possible to prepare such an interesting and instructive article, and the author is to be congratulated on his splendid work.

AID IN IMPROVING FISHING OPERATIONS.

Activities in this field have been confined mainly to aiding in the determination of the value of aircraft for spotting fish, to provision for supplying reports from certain lightships and lighthouses regarding the presence of schooling fish to the trade, and to studies of construction and operation of fishing apparatus, the use of which is limited.

FISHERY INTELLIGENCE SERVICE.

The search for fish in the sea is difficult and hazardous. In proportion to cash returns, the expenditure of time, labor, and materials is heavy. Vessels may seek catches of bluefish, mackerel, menhaden, or tuna for weeks without appreciable results. A vessel may discover good fishing but in the absence of means of communication can not advise other relatively near-by vessels operating unsuccessfully of the location of the schools. In a calling conducted under such handicaps it is important that use be made of every available aid and of every new development of science which promises to increase efficiency of operation without danger to the supply of the future.

As early as 1883 the aid of the United States Life Saving Service was enlisted by the United States Commission of Fish and Fisheries in reporting the presence of whales and other cetaceans and rare sharks and supplying information regarding them. At various times the Bureau's vessels have been employed in behalf of the fishing industry in locating schools of fish such as mackerel and tuna. In 1917, the Bureau of Fisheries, with the aid of the Washington-Alaska Military Cable and Telegraph System, operated by the War Department, inaugurated an intelligence service to communicate by telegraph to a number of coastal towns in Alaska the current prices of certain species of fishes offered at Seattle and Ketchikan. This service furnishes at a very small cost information which could not be gotten by private individuals without considerable effort and cost and is appreciated. Details of this service are to be found in Alaska Fisheries and Fur Industries reports of the Bureau for the years 1917 to 1921.

USE OF AIRCRAFT.

In April, 1919, attended by representatives of the New England fisheries, the Bureau of Fisheries, and the patrol division of Naval Aviation, a conference was held in Washington, D. C., at which tentative arrangements were made for a properly qualified observer

to make flights over such parts of the Atlantic as seemed necessary for spotting schools of fish, such as mackerel, and for forwarding the information obtained to organizations of the fisheries. At this meeting the subject of direct communication between planes and fishing vessels by means of the radio telephone was considered. The possibility of employing seaplanes to advantage in the menhaden fishery was also called to the attention of operators in the Chesapeake region, but nothing resulted from either of these negotiations during the year.

On July 28, 1919, W. W. Welsh, scientific assistant, Bureau of Fisheries, made a flight of about $1\frac{1}{2}$ hours in a naval seaplane from Cape May, N. J., to Five Fathom Bank. This flight was made at a speed of about 40 miles an hour at an altitude of 500 to 1,000 feet. Mr. Welsh reported that no schools of menhaden were breaking water at the surface but that large numbers of small schools were observed at estimated depths of from 2 to 10 feet or more. He stated that:

The range of visibility of the menhaden schools varied according to the depth of the school and the angle of incidence of the sun's rays. Had the fish been ruffling the surface they could have been seen as far as the size of the school and the atmospheric conditions permitted. This was evident by the visibility of tide rips and cat's-paws of wind upon the surface. The deeper the school the more necessary it was to approach it in order to see it. The deepest schools observed were only visible from directly above. When the sun's rays were reflected from the surface, it was impossible to see anything, and the visibility improved as the eye was directed away from the angle of incidence of the sun. On the particular day in question the majority of the schools of fish were at such depth that they were invisible at a greater angle than 45° or 50° from the nadir, and then only on the side of the plane away from the sun. But some schools nearer the surface could be seen much farther off. Besides the general value of such observations, in no other way can such a clear idea be obtained of the abundance or scarcity of schooling fish and the characteristic appearance of the schools. * * *

The most evident opportunity for the practical use of aircraft in the commercial fisheries at the present time lies in their employment as scouts for the purse-seine fishermen in the pursuit of such species as menhaden, mackerel, bluefish, bluebacks, kyacks, and other schooling fish. In the case of the spring mackerel fishery it is believed that the use of aircraft would save much time in locating the fish upon their first appearance and in enabling the fishermen to keep in touch with the fish as they appeared farther north.

In January, 1920, representatives of the Naval Aviation Service and the Bureau of Fisheries again discussed the possibility of using seaplanes in locating fish on the north Atlantic coast, and on February 25, at the request of the Secretary of Commerce, the Secretary of the Navy authorized the experiment, and the proposal was placed before various fishery organizations. The menhaden fishermen showed constructive interest in the subject, and the commandant of the Fifth Naval District detailed two Navy seaplanes, with pilots, and the fishing companies provided observers familiar with the species.

The fishing areas in Chesapeake Bay and along the coast between Assateague and Bodie Island Lights were blocked off into lettered sections and numbered subdivisions for expediency in transmitting information as to the location of schools sighted. At first this information was communicated to the fishing vessels by signal flags suspended from the plane. Later after the installation of radio equipment on two vessels and at the shore station of one of the companies, a radio operator accompanied the plane to transmit the messages as soon as the fish were located. These daily patrols were continued from June 14 to October 1, when the Navy Department abandoned

them on the ground that the experiment had fully demonstrated the commercial value of planes in this fishery. This first thorough test of aviation as an adjunct to the commercial fisheries has proved of great benefit to the industry, and the purchase of planes by the fishing companies is being seriously considered.

In December, 1919, as a result of arrangements between the naval authorities, the fishing interests, and the State commission, naval seaplanes were given trials at San Diego, Calif., for spotting schools of fish. They are reported to have been of some value in locating schools of sardines, but their usefulness in locating albacore, tuna, and yellowtail remains to be more definitely established. In the summer of 1920 a hydroairplane was operated for a time at San Pedro, but was not entirely successful. A dirigible trip was also made at San Diego by an official of the State commission for the same purpose. The aviation service of the United States Coast Guard, Treasury Department, has shown an interest in the utility of fish spotting in connection with its air patrol and training, and the Bureau of Fisheries is endeavoring to effect cooperation between the aviation station of that service at Morehead City, N. C., and the fishermen of that region.

The work done has yielded results of value, but should be continued for the purpose of ascertaining the value of aircraft in other fisheries, such as mackerel, bluefish, tuna, and herring.

NEW ENGLAND FISHERY INTELLIGENCE SERVICE.

In the summer of 1920 the Bureau investigated the possibilities of securing useful information daily from keepers of certain lightships and lighthouses as to the presence of schooling fish, such as mackerel and pollock. Through the courtesy of the Director of Naval Communications and the Commissioner of Lighthouses, the Bureau of Fisheries made arrangements to have the occurrence of such fishes reported by the keepers of *Pollock Rip*, *Nantucket Shoals*, and *Fire Island* lightships. This service was initiated about November 1, 1920, messages reporting any observations made during the preceding 24 hours being sent by radio at noon daily from these vessels to shore stations and forwarded to the Bureau's agent at Boston for dissemination and transmittal to agents in Gloucester and Portland. It was appreciated that the service was being established near the close of the season, but it was desired to have it in efficient working order on the resumption of more active fishing in the spring. If the service proves of value it is planned to increase the number of stations from which reports are received.

NOTES ON FISHING GEAR.

The following descriptions of fishing gear employed in the California fisheries have been furnished by R. A. Coleman, agent, Bureau of Fisheries. The use of the paranzella and lampara nets in American waters is practically restricted to southern California.

PARANZELLA NET.

The paranzella is the net chiefly used in deep water and bottom fishing on the California coast, especially by the large fishing companies operating with steam and power boats. This type of net (the

Italian word "paranzella" means a sloop or fishing boat propelled by sails, and this net was always used with such boats) has been in use on the Mediterranean for a long period. It is said to have been introduced in California in 1876. It is a heavy and strongly constructed net, intended for dragging the bottom in a manner similar to the otter trawl, although it is of quite different make. It proves an efficient means of taking fish.

There is no strict uniformity in the method of construction. The differences are, however, relatively slight, and the type is constant. The nets differ in length from 25 to 35 fathoms and in form according to the use to be made of them and individual fancy. They are made in several sections or "pieces," varying from four to eight.

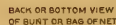
The net illustrated (fig. 2) and on which the discussion is based is the true type of the paranzella and has eight pieces. The first, the wings, which are 150 meshes (3-inch) in length by 300 in width, are made of No. 9 or 12 cotton twine. The wings are often more extended, if it is desired to obtain greater sweep, and may reach considerable length. The second piece is 200 meshes ($2\frac{1}{2}$ -inch) in length by 300 in width, of No. 9 twine. The third is 100 meshes in length ($2\frac{1}{2}$ -inch) by 250 in width, of No. 12 twine. The fourth is 60 meshes in length ($2\frac{1}{2}$ -inch) by 225 in width, of No. 18 twine. The fifth is 18 or 20 meshes ($3\frac{1}{4}$ or $3\frac{1}{2}$ inch) in length by 270 in width, of No. 42 or 60 twine, and is practically a portion of the bunt. Many nets omit this piece entirely. The sixth piece forms the bag, or bunt, proper. It is 60 meshes (4-inch) in length by 220 in width, of No. 84 twine. Sometimes the top is made of $3\frac{1}{2}$ -inch mesh, No. 42 twine, while the sides and bottom are 4-inch mesh, of No. 84 twine or rope. The other pieces are the ques (*scagnetto*, in Italian), which serve to strengthen the net, and especially to help carry the weight of the bag. The top que is 62 meshes (4-inch) wide at the front end, tapering to 30 meshes at the back end, reduction being made at the center, 9 fathoms long. The bottom que is 42 meshes (8-inch) wide in front, tapering to 30 meshes at the other end, reduction being made in the center, and is 8 fathoms long, No. 64 twine being used for both ques. It will be noted that the bottom que is about a fathom behind the top que.

The head of the top que is attached to the rope ($3\frac{1}{2}$ -inch soft manila, which carries the wings and takes the strain of the net) in a special manner, as illustrated in the drawing of the net. It does not follow the curve, but its end is straight and is lashed to the rope (using No. 60 or 84 twine), gradually lengthening at the sides of the que to accommodate the curve. Two meshes are picked up by the needle, an overhand knot is made in them, and the lashing led to the rope, when three round turns are taken and fastened.

A crown of about 20 corks, graduated in size, is sometimes attached to the front end of the top que to assist in sustaining it when the strain is expected to be heavy.

For convenience in removing the fish from the bag, either two or three openings, or "doors," are left in the top. These are 20 or more meshes in length and are trimmed with 1 or $1\frac{1}{2}$ inch manila rope and lashed together with No. 9 or No. 12 thread rope. There is also a bottom, or end, door to the bag, trimmed as the others. It is closer to the bottom of the net than to the top.

NET BEING REGARDED AS DIVIDED AT LEAD LINE

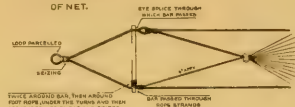


40 MILES WIDE IN CENTER OF WIDTH,
LAPPED TOGETHER WITH (PROPEL)
CLOSER TO BOTTOM THAN TO TOP

CHINA OF 20 CORNS OF GRADUATED SIZES,
SOMETIMES ATTACHED TO TOP OF QUE TO AID
IN SUPPORTING IT



NET BEING REGARDED AS DIVIDED AT CORN LINE.



F-5, 6 FISHERMAN'S NOT
OFTEN USED IN NETS
MADE BY MACHINE.



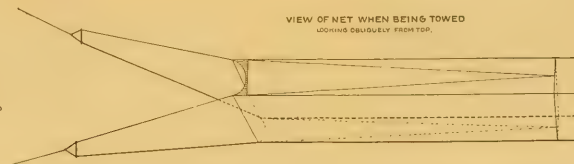
 中国蛋白质化学与分子生物学学会
 CONFOEDERATE
 BIOLOGY



NET MAKER'S NEEDLE,
MADE ALL SIZES FROM
3' OR 4' UP TO 12'.
GENERALLY OF HARDWOOD,
BUT SOMETIMES OF BRASS
OR OTHER MATERIAL.



LOOKING OBLIQUELY FROM TOP.

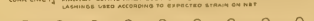


PARANZELLA NET

TAKING 3 MESSED TO THE LASHING



CORK LINE 1¹ MANILA CORKS ARE ABOUT 5" IN DIA AND EITHER ROUND OR OVAL



PARING & MESHES TO THE LASHING



BOTTOM OR LEAD LINE, SOFT MANILA NO 120
LEADS ARE 5' LONG, MADE OF SHEET OF LEAD BEATEN TIGHT ON LINE
THROUGH RINGS IN TWO PLACES TO FIT BORE AND LAPPED ON

FIG. 2.—PARANZELLA NET.



The cork line is about 35 fathoms long, of $1\frac{1}{4}$ -inch manila rope. It carries about 35 corks on each side. These corks are either round or oval and are about 6 inches in diameter, perforated in the center for reeving on the line.

The lead line, which really carries the weight and strain of the whole net, is of soft manila, and varies in circumference from $3\frac{1}{2}$ to $4\frac{1}{2}$ inches, according to size of net and preference of maker. The lead line bounds not only the longitudinal bottom of the net, but likewise the entire four sides of the end of the bunt, thus giving great strength and lifting power to that part. It is also practically continuous over the front of the net, being carried along the lower sides of the wings to the towing bar, and thence around the top of the wings and front, or top que, and of the net, making a complete circuit. Sometimes the portion bounding the upper sides of the wings and top que is a half inch or so less circumference (of soft manila) than the lead line proper. This upper portion of the line carries 6 or 8 wooden thimbles to the side, similar to those on the lead line, though generally more rounded in shape. These are intended to prevent chafing when the net is hoisted aboard.

The lead line proper carries 6 to 10 leads on each side. These leads weigh 1 pound each. They come in flat pieces and are beaten into place about the line. (Some fishermen say that leads are not necessary at all, as the weight of the net holds it well at the bottom.) In addition there are on each side 4 wooden thimbles about 8 inches long. They are turned in two pieces to fit the rope and are lashed about it. Their purpose is to lessen the chafing.

The towing bar is about 24 inches in length by 2 inches in diameter, of pine or hardwood. For details of the method of its use, and also for the method by which the weight and strain of the net is taken at the towing end, reference is directed to the illustration. The ring by which the net head is attached to the towing bar hangs about 6 feet behind the bar.

The net is hung from the cork line by lashings, or seizings, at intervals of either three or four meshes, according to expected strain, and the loops are allowed to fall about 6 inches below the cork line.

From the front top corners of the bag two 60-fathom, $4\frac{1}{2}$ -inch hard manila ropes are attached. These are led to the winch when the net is being hauled, in order to carry the weight of the bag with its load of fish. Two 5-fathom ropes of the same size, or sometimes $3\frac{1}{2}$ -inch, are attached to the top back corners of the bag, and when it is desired to hoist the bag on board these are bent onto the 60-fathom ropes at the front end of the bag, which is thus hoisted from its four corners.

The fish are taken from the net through the doors with a heavy scoop net of $2\frac{1}{2}$ or 3 feet diameter, with strong wooden handle. These scoops are sometimes so heavy that it requires two men to operate them.

The net is towed by two 60-foot, or more, seagoing fishing boats. The towing lines or warps are of $3\frac{1}{2}$ -inch hard manila 700 or 800 fathoms in length.

Operations are carried on in the following manner: When it has been determined by sounding that a suitable bottom has been found, the boat which carries the net slows down. The other boat comes alongside and passes its towing line to the first. This is attached

to one wing of the net. The boats then separate, the net is shot, and they begin paying out their respective warps through special shackles at the stern. After 50 or 60 fathoms have passed out an iron weight, or sinker, weighing 25 to 35 pounds is attached to each line, in order to sink the net, and the remainder of the rope, 450 or 500 fathoms, is paid out. The towing speed varies from $2\frac{1}{2}$ to 4 knots per hour. The opening in the net is about 12 fathoms from one towing bar to the other. Ordinarily the boats tow about 800 feet apart. In stormy weather this distance is somewhat reduced, and in fine weather is extended.

In some instances fishermen prefer to purchase the bunt of their nets ready-made, in which case it is usually made by machinery. Sometimes, also, other parts of the net are purchased. A figure-eight knot is generally used in machine-made nets, but the parts made by hand are almost always made with the customary fisherman's knot. The illustration is not drawn to scale.

LAMPARA NET.

This net originated in the Mediterranean, where it has long been in use. It is said to have been brought to California about 1900. The lampara is so called from the Italian word "lampo," meaning lightning, because used chiefly in taking sardines, anchovies, and other small fishes which move with great quickness in the water, flashing as they swim. These fish are usually taken at night, in the "dark of the moon," since by day, or even on moonlight nights, they see the nets and avoid them. The lampara differs from the paranzella in that it is intended to take fish at the surface or at but a short distance below, while the paranzella is dragged on the bottom.

Although the lampara nets are used chiefly for taking sardines and other small fish, especially for bait, some nets of large dimensions—up to 2,000 feet in length by 150 in depth—have been constructed of strong, heavy twine for the capture of larger fish, such as sea bass, barracuda, yellowtail, etc. In these cases the range of size of mesh may vary from 2-inch stretched mesh in the bag to 20-inch at end of wings. So far, however, such nets have not proved a general success, as they are awkward to handle on account of their large size, and the fish captured in them are so powerful that they often tear the net.

The accompanying drawing (fig. 3) and description of the lampara net are based on information supplied by E. M. Nielsen, assistant to the California Fish and Game Commission at Monterey, and were taken from a net of average size and make owned by a local fisherman.

Referring to figure 3 and its legend, it will be noted that section 3 is of heavy netting to withstand wear and tear when the fish are taken out of the net and section 4 acts as a wall to prevent the fish from escaping. Section 5 is light and of small mesh so that the fish do not gill in it; the net is usually fished in the dark of the moon, and the phosphorescence in the water tends to deflect the fish from the wings backward toward the bag of the net. The lead line is $\frac{3}{4}$ -inch diameter hemp rope and carries lead weights to a weight of about 150 pounds, the leads being about 18 inches apart.

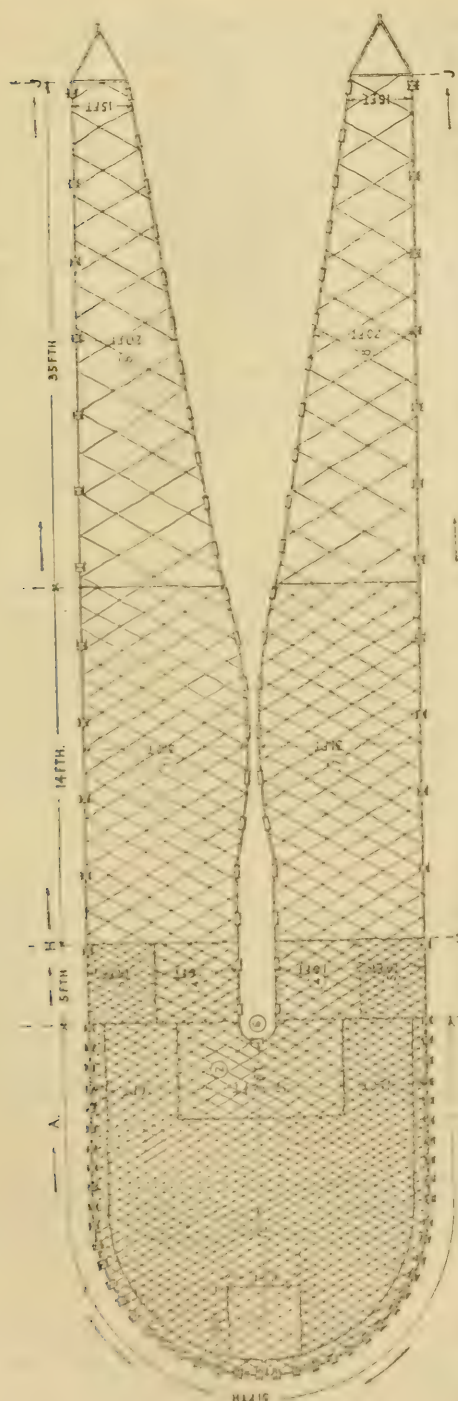


FIG. 2. - LEAD LINE NET. Section 1, 23-6 thread, $\frac{1}{2}$ -inch mesh; 2, Mendocino or key of net 6-ply, 3-inch mesh; 3, heavy netting, 6-ply, 1-inch mesh, 8 by 8 feet; 4, 6-ply, 3-inch mesh; 5, part of bag of 23-6 thread, $\frac{1}{2}$ -inch mesh; 6, horseshoe, where wings divide; 7, wing-section of 3-inch mesh; 8, wing-section of 8-inch mesh; 9, strip of netting 10 inches wide, 16-ply, 1-inch mesh of heavy mesh, to hold bag to cork line and withstand wear and tear; 10, cork line of $\frac{1}{2}$ -inch diameter hemp rope, 500 corks in pairs, 6-inch interspace between pairs; 11-12, wing cork lines, 300 corks in pairs on each wing, interspaces about 3 feet.

The lampara net is made of cotton twine and may be operated either with one large boat or with two boats. The operation with one boat is carried out as follows: When a school of fish is located, one end of the net is thrown out with a buoy attached, sometimes anchored; then the boat is pulled around the fish in a circle, paying out the net until the boat is back to the buoy from which it started. Then an anchor is generally put over the side away from the net to hold the boat off. Then the fishermen start hauling both ends of the net from the bow and the stern, until the bag is hauled up alongside. After getting the wings into the boat and the bag alongside, the fish are dipped out into the well or box. The net is then overhauled and made ready for another lay. From three to five men are required to operate in this way.

When two boats are used, the bag is dropped first; then the fish are circled by the boats pulling in opposite directions, paying out the coiled net until they meet, passing one another, one end of the net being passed over the other and the boats anchored. The wings are crossed while the net is being hauled in. The bag is thus hauled up between the boats, when the fish are taken out. Six to eight men are required to operate in this way.

A modification of the lampara has sometimes been used of late, consisting of a purse, or semipurse attachment. It is in all respects a lampara net except that a purse line is added to the bunt of the net, which enables the operators to pull the lead line in more quickly after the net is partly in, thus impounding the fish in the bunt of the net. It is claimed that by this device it is easier to catch the fish in the daytime without their sounding and getting under the net when operating in deep water. A shallower net may be used, thus making its operation quicker and more economical. This device has not, however, been generally adopted.

HERRING GILL NET.

The herring gill net used in San Francisco Bay, Calif., is usually about 50 fathoms in length by 2 in depth. It is made of 2-inch mesh, 2-ply cotton twine. The top strip of meshes, 3 or 4 inches wide, abutting the cork line, is made of 4 or 5 ply twine to give it greater strength. The cork line is one-half inch diameter manila, with corks, 2 inches in diameter, at intervals of 2 feet. The lead line is three-eighths-inch manila, and the leads, weighing about 4 ounces, are 3 feet apart. The net is operated from one boat and is handled by two men. These nets are generally purchased ready-made.

SMELT NET.

Smelt nets in use on San Francisco Bay are usually made of linen twine. They are 28 to 30 fathoms long by 10 to 12 feet in depth and are constructed of $1\frac{1}{2}$ or 2 inch mesh. In other respects they resemble the herring nets.

TRAMMEL NET.

A three-web trammel net observed in use in southern California was 200 fathoms long by $2\frac{1}{2}$ deep. The small web was of $7\frac{1}{2}$ -inch mesh, and the large outside webs of 18-inch mesh.

DEVELOPMENT OF IMPROVEMENTS IN METHODS OF HANDLING, DISTRIBUTING, AND MARKETING.**FRESH FISH.**

One of the most important means for increasing the consumption of fish is to supply the consumer with a product closely approximating the quality of the fish as taken from the water. This necessitates reducing the amount of deterioration from "catch" to consumer to a minimum. Considering the length of time that elapses after the fish are taken from the water until they reach the consumer, some deterioration is inevitable, but that a marked degree of improvement in reducing the amount can be made is undoubtedly possible. With such improvement many persons who now enjoy freshly caught fish, but who rarely buy "fresh" fish in the market, will be added to the list of regular consumers. As deterioration sets in as soon as the fish are dead, the first step is to improve methods of handling the fish on boat or vessel and at the points of distribution.

It is important to handle fish with the greatest possible care, to avoid bruising or forking them, and to avoid warmth. Fish should be handled with the same care as fruits; they should not be forked, bruised, tread on, thrown about needlessly and roughly, or piled too deeply in boat, box, or barrel. Failure to observe these precautions will cause spoilage just as the spoilage of fruits is hastened by similar treatment. The temperature of fish is about the same as that of the water in which they live, usually slightly higher. Fish taken from warm water will therefore spoil more quickly than if taken from cold water. The warmer the water is the greater the care required to prevent spoilage. If the fish taken from warm water are piled deeply it is but natural that the temperature of the mass will shortly begin to rise, with resultant spoilage. It is therefore important to keep the fish away from warmth and to cool fish taken from warm water as quickly as possible.

The Bureau has impressed upon those in the fisheries the importance of avoiding the use of fork or pew as far as practicable, using where necessary only a one-tined fork and forking the fish in the head instead of the body, and has encouraged the installation of precooling devices to remove the body heat of the fish as speedily as practicable. It is believed that a cold brine circulatory system or an adaptation of the system of freezing fish in brine may be worked out for use on vessels or boats. In fact, some experiments have already been made to this end by those in the fisheries.

There is fully as great if not greater need for improving methods of distribution and the handling of the fish in the retail markets. The shipper should consider the advantages of packing the fish in shallow boxes instead of in barrels; and the retailer, in view of the length of time that has elapsed since the fish were caught, should observe every precaution which will retard deterioration as well as offer the fish for sale in an attractive manner and amid sanitary surroundings.

KIPPED FISH.

The preservation of fish by smoking is a very ancient and widely known practice. The products preserved in this manner are among the tastiest of foods. The necessity for marketing the product

within a short period of time has restricted the volume of production and confined the practice largely to the centers of consumption. To minimize these difficulties the canning of the smoked fish has received greater attention in recent years, much of the product being labeled as kippered fish. In the preparation of such fish a variety of practices have sprung up. For example, of 10 packs recently examined, in 1 pack the fish were split through the back, in 2 they were unsplit, and in the remaining 7 they were cut lengthwise into separate sections. Nine packs contained headless fish; one, tailless. In Service and Regulatory Announcements No. 26 of the Bureau of Chemistry, issued December 30, 1920, the following tentative definitions are recognized by that bureau:

Kipper.—A fish which has been split through the back from tail to head, eviscerated, lightly salted, and lightly smoked. Example, kippered herring. **Kipper unsplit.**—A fish which has been headed and eviscerated (but not split), lightly salted, and lightly smoked. Example, kippered herring unsplit.

The characteristic appearance of kippered herring and bloater herring as prepared for the smoked fish market are shown in figure 4.

INCREASING THE USE OF FISH AS FOOD.

A summary of the conditions affecting the marketing of fish has been given in the introduction to the present report and attention called to the handicaps under which the Bureau has labored in meeting the menacing situation which confronted the industry. Efforts to obtain additional funds for demonstrations in fish cookery and similar activities were unavailing and the Bureau's activities were limited almost wholly to the issuance of helpful economic circulars and placards and to furnishing informative matter.

THE HADDOCK.

With the recent increase in the number of trawlers operating in the New England fisheries, there has been a large increase in the catch of haddock, resulting in the production of this species in excess of the market demand. To illustrate, the vessel landings at Boston and Gloucester for the three-year period 1918 to 1920 increased about 50 per cent in comparison with the period 1908 to 1910, and for Boston, Gloucester, and Portland, the landings in 1920 were nearly 30 per cent greater than in 1916, while the increase in the price to the fishermen was but \$0.006 per pound. The landings of the vessel fisheries at these ports in 1920 amounted to 73,345,581 pounds.

The Bureau has issued a placard and a small cookbook ² recommending the use of this fish. In this economic circular attention is called to the fact that the haddock is abundant on the great fishing banks which stretch from Cape Cod to Newfoundland, and at certain seasons frequents the shores; that it is a relative of the cod, one of the "dry" fishes, and possesses many of the same qualities, the average constituents of the two fishes, based on a number of analyses, being as follows:

| | Proteins. | Fats. | Ash. | Water. |
|--------------|------------------|------------------|------------------|------------------|
| | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
| Haddock..... | 17.10 | 0.26 | 1.25 | 81.39 |
| Cod..... | 16.00 | .30 | 1.24 | 82.46 |

² Moore, H. F.: The Haddock: One of the Best Salt-water Fishes. With Recipes for Cooking It. Bureau of Fisheries Economic Circular No. 47, 8 p., issued Aug. 18, 1920. Washington.



FIG. 4.—UPPER, KIPPERED HERRING; LOWER, BLOATER HERRING.

FROZEN FISH.

Freezing conserves fish in times of abundance and cheapness for use in times of scarcity. As a rule fish are now frozen under excellent conditions, usually within a short time after they are caught. If perfectly fresh when frozen, if properly stored, handled, and prepared for the table, they are often superior in quality, texture, and flavor to fresh fish shipped long distances packed in ice. Some of the important species frozen are whiting, halibut, cod, hake, haddock, pollock, ciscoes, salmon, mackerel, sablefish, squeteague, smelts, whitefish, lake trout, butterfish, croakers, shad, and yellow pike.

As an aid to increasing the consumption of frozen fish and removing certain prejudices, the Bureau has issued a poster and leaflet recommending this commodity. The leaflet stresses the importance of keeping frozen fish at a low temperature until used for food and of never thawing and refreezing or subjecting them to rises in temperature or bruising, and emphasizes the necessity of buying them frozen and placing them in an ice box or cool place for thawing before cooking. For statistics of the holdings of frozen fish by species and by months in 1920, see page 52.

TECHNOLOGICAL INVESTIGATIONS.

The small appropriation granted for the fiscal year beginning July 1, 1920, has made it impossible to conduct regular investigations in this field, limiting the work mainly to a review of literature of methods which will be helpful in future investigations and to certain minor activities which could be done at little expense. Appreciating the importance of the technological investigations in progress at the experimental plant at San Pedro to the fisheries of the Pacific coast, the California Fish and Game Commission has taken over the laboratory and is operating it for the current fiscal year.

SALTING RIVER HERRING.

The technological investigations of the basic principles governing the salting of fish which have been described in previous reports have revealed the possibilities of effecting certain refinements and improvements in common practice, of salting fish at higher temperatures and therefore in warm climates and of producing a product superior to much of that now marketed. In order to give practical application to the results, arrangements were made to initiate the salting of fish at points in Florida where previous attempts by usual methods had failed. A practical salter of long experience was employed, given instructions and opportunity to try out these improvements in the Bureau's Fishery Products Laboratory, and detailed to Welaka, Fla., for instructing local fishermen desirous of giving such methods a trial.

At Welaka the run of river herring lasts from about January 1 to March 15. During the early part of the season the catch is marketed without difficulty, but later when the fish appear at more northern points the demand diminishes and the price falls to a point at which it is unprofitable to continue fishing. The possibility of salting the fish taken at this period was welcomed by the local fishermen.

The instructions given resulted in the successful salting of 80,000 fish, and purchasers of the fish expressed a high appreciation of the quality of the product. Plans were developed for establishing local markets for the fish and for conducting the work on a large commercial scale.

A paper³ by the Bureau's technologist, H. F. Taylor, has been published by the Bureau for the use of fish salters, and it points out the practical application of the principles developed by work in this field. These include the careful handling of fish before salting; thorough cleaning, especially the removal of all blood; the use of salt of a high degree of purity; and the application of salt in the dry condition.

REFRIGERATION OF FISH.

To supply authoritative technical data bearing on the refrigeration of fish, the relative merits of freezing fish in air and in brine and the like, the Bureau has assembled necessary equipment including electrical measuring apparatus. Lack of funds and the loss of technological workers have prevented the prosecution of this investigation. The demand for the Bureau's data on refrigeration, particularly freezing in brine by the various processes, has been heavy and it is believed has been highly appreciated by the trade. Practical application of the principles in the precooling and freezing of fish have been made and give promise of effecting important advances in the distribution of fish of excellent quality. The possibilities of precooling the catch as taken by the fishing vessels merit serious consideration. A number of demonstrations of brine freezing have been made by the Bureau during the year. As a result of demonstrations given for the benefit of representatives of the Bureau of Plant Industry, that bureau has made provision for the application of this method to the freezing of fruits and vegetables and is conducting investigations in its particular field.

CANNING OF PACIFIC COAST FISHES.

When the Bureau equipped its small experimental canning laboratory in southern California, one of the more pressing lines of investigation was the development of satisfactory methods of canning little utilized fishes to render available larger quantities of protein food and conserve meat. As a result much attention was given to the possibilities of developing suitable methods for canning such fishes as mackerel, bonito, barracuda, sea bass, and smelts and to improving the packs of pilchard, tuna, and yellowtail. Several hundred packs were put up and held in storage for examination periodically, and in a few cases methods which appeared unusually promising and for which there was an immediate demand have been released. The results of this work are being prepared for publication. With the lessening of the demand for greatly increasing production and in view of the underconsumption of fish and difficulties of marketing not only new fishes, but staple varieties, in recent months the laboratory has concerned itself with the more important work of developing standard methods

³ Taylor, Harden F.: Improvements in Process of Salting River Herring, Especially Adapted to Warm Climates. Appendix II, Report, U. S. Commissioner of Fisheries for 1921, 7 p., B. F. Doc. 903. Washington, 1921.

of canning the usual species which will yield standard packs and to the solution of the practical problems of the canners. For example, it is making a careful investigation of the possibilities of recovering the fry bath oil and of keeping it free from the objectionable substances acquired by continued use. This problem is much more complex than was anticipated when the work was undertaken and, if it can be solved, it will be of marked value to the industry.

PRESERVATION OF FISH NETS.

Most of the investigations in the preservation of nets have been made in Norway, very little investigation or experimentation being noted in the fishery or scientific journals in other countries. This important means of economizing in the expense of nets appears to have been largely neglected in the United States, the principal preservative used being tar, which can be used only for the coarser kinds of nets. As the fishing gear employed by our fishermen represents an investment in excess of 15 million dollars, a large part of which is in twine, and in view of the increased cost of such netting, the importance of lengthening the life of such gear will be appreciated. To contribute to this end, a paper on the subject has been prepared,⁴ reviewing the literature of the subject, presenting the fundamental principles so far as they are known, and giving for use those recipes which, from a chemical standpoint, seem best calculated to serve their purpose. In addition provision is being made for the conduct of additional tests for the purpose of affording still further aid to our fishermen.

INCREASING THE USE OF BY-PRODUCTS OF FISHERIES.

Although the Bureau's activities in this field during the year were practically confined to suggestions through correspondence or by personal visits, the results achieved have been exceedingly gratifying and important progress is to be noted in the saving of fish waste, the manufacture of fish meal, the production of fish leather, and the utilization of fish scales. The decline in value of fish oil and scrap to prewar levels will undoubtedly affect operations in 1921.

FISH OILS.

By converting the figures published by the Bureau of the Census in Animal and Vegetable Fats and Oils for calendar years 1919 and 1920, on the basis of $7\frac{1}{2}$ pounds to the gallon, the production of fish oils in gallons in 1920 was as follows: Menhaden oil, 3,676,453; whale oil, 3,073,574; sperm oil, 416,737; herring oil, 380,379; cod and cod-liver oil, 196,108; and all other, including marine animals, 1,060,322; a total of 8,803,574. On the basis of reports from the Pacific Coast States and Alaska, the production of fish oils in 1920 approximated 3,066,000 gallons.

Imports of fish oils entered for consumption for the calendar year 1919 amounted to 2,599,072 gallons, valued at \$2,928,993. This

⁴ Taylor, Harden F.: Preservation of Fish Nets. Appendix IV, Report, U. S. Commissioner of Fisheries for 1920, 35 p., 1 fig., B. F. Doc. 898. Washington, 1921.

amount includes cod oil, 1,152,252 gallons, valued at \$1,107,221; cod-liver oil, 235,805 gallons, valued at \$665,080; herring and other fish oils, 542,112 gallons, valued at \$437,836; seal oil, 23,121 gallons, valued at \$21,598; sperm oil, 124,747 gallons, valued at \$124,511; and other whale oil, 521,035 gallons, valued at \$572,747. The exports of fish oils in 1919 amounted to 1,085,551 gallons, valued at \$976,831. Of this amount 526,980 gallons, valued at \$401,466 went to England; 409,122 gallons, valued at \$353,221 to Scotland; and 59,722 gallons, valued at \$70,309 to Canada.

FISH SCRAP AND MEAL.

The estimated production of fish and whale scrap and meal in 1920 was 130,000 tons, a material increase over previous years. Of this amount, 16,898⁵ tons are credited to the Pacific Coast States and Alaska. On the west coast, as a result of the heavy demand for fertilizer material, more than the usual amount of scrap was used for this purpose. In the menhaden industry of the Atlantic coast, the value of the Bureau's assistance in encouraging the production of fish meal has been greatly appreciated. At least 5,000 tons of meal was turned out by the producers in 1920 and considerable quantities of unground scrap are reported as sold to manufacturers interested in supplying stock feeds. The Bureau of Animal Industry of the Department of Agriculture has continued its hog-feeding tests, using various fish meals, and samples have been supplied to some 15 State experiment stations with satisfactory results. The experiments in progress include the feeding of meal of high oil content, samples without removal of natural oil with additional oil added, and meal made from decomposed fish. If these tests yield satisfactory results, the producers of fish meal should be reasonably assured of markets for their product as soon as the farmers have become acquainted with the merits of this commodity. The whaling companies have recently expressed an interest in the manufacture of whale meal and have provided material for a feeding test.

Considerable quantities of fish waste and waste fish incident to the New England fisheries remain unutilized, and in some cases its disposal is an item of no little expense to the producer. Lack of a regular supply makes the operation of the larger reduction plants impracticable, and the smaller plants appear to be not wholly satisfactory for the proper reduction of some of the raw materials in greatest abundance. The Bureau appreciates the need of solving the problems of this field and hopes to be in position to take them up in the near future.

FISH LEATHER.

Notwithstanding the increase in the usual supplies of materials for tanning into leather, the possibilities of employing the hides of sharks and other unutilized aquatic animals continues to attract attention, and the number of inquiries for detailed information is large. Several companies are interested in developing the industry and in the establishment of fisheries for these forms. The Bureau of

⁵ See Pacific Fisherman Yearbook, January, 1921, p. 105-106.

Standards is continuing its investigations of the characteristics and qualities of these leathers. One sample of shark leather possessed a tensile strength in excess of 6,500 pounds per square inch exceeding that of calfskin tested. Wearing tests of shoes are also being made. For this purpose 14 pairs of shoes, one shoe of each pair of shark leather and its mate of calfskin; seven pairs of shoes, one of porpoise and mate of side leather; and two pairs of shoes, one shoe of whale leather and mate of calfskin, are being used. It is assured that leather of good quality can be made from shark hides, and ready markets thus far have been found for good grades. There is need for more attention to the subject of quantity-production, to the trial of small, easily movable reduction plants to care for the oil, scrap, and fins, and to developing the interest of fishermen to save and utilize their catch of sharks. A report is being prepared covering the investigations in this field.

SHARK FINS.

There is an apparent demand for a much larger supply of dried shark fins. San Francisco is the center of the industry in the United States, the receipts at that port amounting to about 5 tons per month. Much the larger portion is imported from the west coast of Mexico, the balance being received from California points and a few shipments from the Atlantic coast. The Chinese merchants are the largest buyers and export the bulk of the material to China, the balance being absorbed by the local trade.

Unlike conditions in the principal oriental markets, very little distinction as to the species of sharks from which the fins are taken is made, provided the fins are of good size, properly trimmed and cured. The fin should be cut off at the body, with all fleshy parts trimmed off, leaving only the true fin. The marketable fins are the dorsal on the back, the pectorals or anterior paired fins, and the anal. The large dorsal is preferred, while the caudal or tail is worthless. The fins must be at least 6 inches long, and those ranging from 8 to 14 inches are preferred.

For curing the fins should be thoroughly dried in the sun without salt or other treatment, then packed, preferably in cases or barrels weighing about 250 pounds, or put up in sacks to weigh 150 or 200 pounds. Choice grades have commanded as high as 65 to 75 cents per pound, but fins badly cured, improperly trimmed, etc., command much less.

PEARL ESSENCE OR FISH SCALE ESSENCE.

The art of using the silvery pigment from fish scales for ornamental purposes is said to have been discovered by the Chinese. In 1680 artificial pearls were first made in western Europe by Jacquin, a rosary maker in Paris, and the trade has been largely conducted in France, Germany, and Italy. The silvery coating of the scales of certain fishes, freed from organic matter and composed of minute, oblong bodies which en masse under suitable conditions supply an iridescent effect, is employed for the purpose. This material is known as essence d'orient, pearl essence, or fish-scale essence. In the manufacture of the artificial pearls the inner wall of the thin

glass spheres is coated with this essence and the cavity filled with a hard white wax.

In the past the best scales for the purpose were obtained from one of the cyprinid fishes of Europe. The supply of pearl essence was curtailed by the outbreak of the Great War, and in 1915 and 1916 numerous inquiries were received by the Bureau concerning the fishes from whose scales the essence could be prepared and details of manufacture of the essence and of artificial pearls. Such information as could be found was supplied, and some experiments were made with the scales of native fishes. Promising samples, although never free from color, were made from the scales of the alewife, or river herring. After treating the scales with ammonia the lustrous particles were separated out by centrifugation. Samples submitted to American representatives of Parisian pearl manufacturers were pronounced off color and lacking in luster. Later one of the Bureau's technologists made some additional experiments, including the digestion of the proteinaceous material, leaving the lustrous particles and a pearly suspension produced, but the results were not wholly satisfactory. At about this time others had succeeded in making pearl essence from the scales of native fishes and the experiments were discontinued for more important investigations. According to report the scales of the alewife, or river herring, sea herring, and shad are employed. The scales are agitated in an ammonia solution and the lustrous particles separated by straining the liquid through several cloths. The material produced is reported to be fully the equal of the imported essence for the manufacture of artificial pearls. The fishermen receive from 15 to 50 cents per pound for the scales, and considerable quantities are now being used for the purpose.

NEW ENGLAND VESSEL FISHERIES.

GENERAL STATISTICS.

In the vessel fisheries centering at Boston and Gloucester, Mass., and Portland, Me., during the past year the number of trips and the catch were not so large as in the previous year, but there was a considerable increase in the total value of the products. There was a large increase in the products landed at Boston during the year, amounting to 14.67 per cent in quantity and 30.19 per cent in value, while at Gloucester there was a decrease of 34.51 per cent in quantity and 31.93 per cent in value, and at Portland a decrease of 40.22 per cent in quantity and 8.60 per cent in value. Statistics of these fisheries have been collected by the local agents and published in monthly bulletins showing by species and fishing grounds the quantities and values of fishery products landed by American and Canadian fishing vessels during the year at these ports. Two annual bulletins have been issued, one showing the catch by months and the other by fishing grounds.

The fishing fleet at these ports during the calendar year 1920 numbered 471 sail, steam, and gasoline screw vessels, including 41 American and 3 Canadian steam trawlers. These vessels landed at Boston 3,342 trips, aggregating 118,558,902 pounds of fish, valued at \$6,136,569; at Gloucester, 2,381 trips, aggregating 46,740,296 pounds, valued at \$1,460,336; and at Portland, 1,883 trips, aggregating

gating 12,981,503 pounds, valued at \$630,108. The total for the three ports amounted to 7,606 trips, aggregating 178,280,701 pounds of fresh and salted fish, having a value to the fishermen of \$8,227,013. This total includes 54 trips, 43 at Boston, 1 at Gloucester, and 10 at Portland, landed by 18 Canadian fishing vessels, amounting to 2,588,218 pounds of fish, valued at \$119,028. Of this quantity, 1,308,774 pounds, valued at \$62,147, were landed at Boston; 271,580 pounds, valued at \$13,606, at Gloucester; and 1,007,864 pounds, valued at \$43,275, at Portland. There was an increase of 9 vessels and 15 trips, but a decrease of 707,929 pounds in the quantity of fish landed, with an increase of \$12,767 in the value, as compared with the previous year. These fish were landed in accordance with an arrangement with the Canadian Government as an emergency war measure granting reciprocal privileges to fishing vessels, by which Canadian fishing vessels were permitted to land their fares at American ports direct from the fishing grounds. Canadian vessels began to utilize this privilege in April, 1918, and the arrangement is still in operation.

Compared with the previous year there was a decrease of 663 trips, or 8.01 per cent, in the total number landed by the fishing fleet at Boston, Gloucester, and Portland, and of 18,200,569 pounds, or 9.26 per cent, in the quantity, with an increase of \$678,630, or 8.99 per cent, in the value of the products landed. The only important species showing an increase in both quantity and value were halibut, mackerel, and swordfish. The catch of halibut increased 1,674,669 pounds, or 79.19 per cent, in quantity, and \$354,630, or 91.59 per cent, in value; the mackerel catch increased 1,580,525 pounds, or 27.66 per cent, in quantity, and \$215,852, or 39.44 per cent, in value; and the catch of swordfish increased 1,648,942 pounds, or 186.80 per cent, in quantity, and \$281,834, or 132.71 per cent, in value. The catch of cod decreased 3,108,838 pounds, or 4.75 per cent, in quantity, but increased \$54,456, or 2.10 per cent, in value; haddock decreased 7,436,708 pounds, or 8.99 per cent, in quantity, and \$53,886, or 1.92 per cent, in value; pollock, 10,191,066 pounds, or 54.34 per cent, in quantity, and \$118,387, or 31.11 per cent, in value; cusk, 208,459 pounds, or 10.10 per cent, in quantity, and \$14,099, or 22.67 per cent, in value; and herring, 3,361,901 pounds, or 32.45 per cent, in quantity, and \$73,487, or 30.64 per cent, in value. The catch of hake increased 381,880 pounds, or 8.80 per cent, in quantity, but decreased \$27,177, or 15.01 per cent, in value. The catch of Newfoundland herring decreased 404,753 pounds, or 11.55 per cent, in quantity, and \$79,626, or 41.95 per cent, in value. There were no tilefish landed at Boston during the year. In the various other species combined there was an increase of 853,897 pounds, or 20.66 per cent, in quantity, and of \$60,368, or 37.85 per cent, in value.

The following tables present in detail, by fishing grounds and by months, the products landed at Boston and Gloucester, Mass., and Portland, Me., by American and Canadian fishing vessels, for the calendar year 1920. The weights of fresh and salted fish given in these statistics represent the fish as landed from the vessels, and the values are those received by the fishermen. The grades, or sizes, given for certain species are those recognized in the trade.

LANDED AT GLOUCESTER.

East of 69° W. longitude.

By American vessels:

| | | | | | | | | | | | | | |
|-----------------------------------|----|-----------|---------|---------|---------|-----------|--------|-----------|--------|--------|-----|--------|-------|
| La Havo Bank..... | 20 | 401,440 | 11,628 | 36,183 | \$2,071 | 181,565 | 4,407 | 2,970 | \$151 | 1,155 | 11 | 14,480 | 8005 |
| Western Bank..... | 89 | 4,426,460 | 124,426 | 287,063 | 17,443 | 2,967,020 | 73,428 | 306,126 | 17,173 | 51,910 | 557 | 14,480 | 8005 |
| Queereu Bank..... | 73 | 3,710,340 | 105,672 | 301,232 | 44,130 | 4,061,229 | 93,400 | 1,182,255 | 58,741 | 14,870 | 173 | 76,632 | 2,786 |
| Green Bank..... | 5 | 83,435 | 2,410 | 39,305 | 3,275 | 12,660 | 295 | 6,610 | 331 | | | | |
| Grand Bank..... | 25 | 470,367 | 14,246 | 355,095 | 21,088 | 56,500 | 1,447 | 73,120 | 4,105 | 2,430 | 69 | 3,215 | 121 |
| St. Peter's Bank..... | 3 | 265,390 | 7,962 | 4,955 | | 86,035 | 2,151 | 760 | 42 | 1,085 | 41 | | |
| Off Newfoundland..... | 12 | | 2,975 | | | | 1,013 | | | 350 | 5 | | |
| Cape Shore..... | 22 | 95,830 | 714 | 12,260 | 710 | 2,050 | 83 | 1,255 | 63 | | | | |
| The Gully..... | 5 | 19,215 | | 113,065 | 5,663 | | | 149,330 | 7,466 | | | 8,785 | 439 |
| By Canadian vessels: Queereu Bank | 1 | | | | | | | | | | | | |

West of 69° W. longitude.

By American vessels:

| | | | | | | | | | | | | | |
|-----------------------|-------|------------|---------|-----------|--------|------------|---------|-----------|--------|---------|-------|---------|-------|
| Brown's Bank..... | 16 | 218,975 | 7,633 | | | 319,115 | 8,194 | | | 6,470 | 63 | | |
| Georges Bank..... | 180 | 2,245,228 | 67,332 | 46,619 | 2,509 | 2,112,540 | 53,690 | | | 24,736 | 299 | 1,820 | 53 |
| Bedfords Lodge..... | 1 | 6,000 | 103 | | | 7,660 | 172 | | | | | | |
| Upwich Bay..... | 1 | | | | | | | | | | | | |
| South Channel..... | 38 | 136,170 | 4,065 | | | 456,053 | 11,382 | | | 27,398 | 363 | | |
| Nantucket Shoals..... | 49 | 865 | 28 | | | 3,115 | 83 | | | | | | |
| Seal Island..... | 4 | 80,830 | 2,396 | 21,300 | 1,169 | 37,820 | 1,003 | 8,900 | 467 | | | | |
| Shore, general..... | 1,835 | 2,195,290 | 100,951 | 305 | 36 | 35,030 | 803 | | | 3,470 | 51 | | |
| Total..... | 2,381 | 14,086,066 | 452,263 | 1,739,372 | 98,381 | 10,469,452 | 251,643 | 1,812,117 | 92,430 | 133,874 | 1,692 | 101,332 | 4,091 |

LANDED AT PORTLAND.

East of 69° W. longitude.

By American vessels:

| | | | | | | | | | | | | | |
|-----------------------|----|--------|-------|--------|-------|--------|-----|--------|-------|-------|----|--------|-------|
| La Havo Bank..... | 5 | 17,715 | 522 | | | 7,475 | 151 | | | 270 | 3 | | |
| Western Bank..... | 6 | 8,965 | 345 | 1,460 | 95 | 3,790 | 127 | 315 | 20 | | | | |
| Queereu Bank..... | 3 | | | | | | | | | | | | |
| Green Bank..... | 2 | 930 | 50 | | | | | | | | | | |
| Grand Bank..... | 11 | 26,365 | 771 | 4,330 | 270 | 3,790 | 102 | | | | | | |
| St. Peter's Bank..... | 6 | 615 | 31 | | | | | | | | | | |
| Off Newfoundland..... | 1 | | | | | | | | | | | | |
| Cape Shore..... | 11 | 21,835 | 821 | | | 31,140 | 922 | | | 1,710 | 31 | | |
| The Gully..... | 4 | | | | | | | | | | | | |
| By Canadian vessels: | | | | | | | | | | | | | |
| La Havo Bank..... | 2 | 56,540 | 1,920 | 2,085 | 156 | 20,060 | 592 | 575 | 37 | | | 370 | 17 |
| Western Bank..... | 3 | 50,000 | 1,000 | 62,218 | 3,532 | | | 98,046 | 5,393 | | | 24,500 | 1,348 |

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND (GEOFFSTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—(continued).

| Fishing grounds. | Number of trips. | Large (10 pounds and over). | | | | Market (under 10 and over 2½ pounds). | | | | Scrod (1 to 2½ pounds). | | | |
|--|------------------|-----------------------------|-----------|-----------|------------|---------------------------------------|-----------|---------|---------|-------------------------|---------|-------|--|
| | | Fresh. | | Salted. | Fresh. | Salted. | Fresh. | Salted. | Fresh. | Salted. | | | |
| | | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | | |
| LANDED AT PORTLAND—continued. | | | | | | | | | | | | | |
| West of 66° W. longitude. | | | | | | | | | | | | | |
| By American vessels: | | | | | | | | | | | | | |
| Brown's Bank..... | 1 | 31,300 | \$2,504 | | 2,785 | \$223 | | | | | | | |
| Georges Bank..... | 17 | 53,536 | 2,438 | | 11,167 | 326 | | 605 | \$8 | | | | |
| Cashes Bank..... | 13 | 101,916 | 6,695 | | 51,815 | 2,304 | | 26,297 | 267 | | | | |
| Platts Bank..... | 46 | 41,674 | 3,117 | | 34,280 | 1,683 | | 10,825 | 152 | | | | |
| Jeffreys Ledge..... | 57 | | | | 619 | 16 | | | | | | | |
| South Channel..... | 2 | 510 | 20 | | | | | | | | | | |
| Shore, general..... | 1,688 | 1,344,769 | 75,592 | 6,135 | 417,870 | \$434 | | 116,052 | 2,017 | | 395 | \$18 | |
| By Canadian vessels: Georges Bank..... | | | | | | | | | | | | | |
| Total..... | 1,883 | 1,756,850 | 95,859 | 76,218 | 584,731 | 22,072 | 100,311 | 5,532 | 155,689 | 2,478 | 25,465 | 1,383 | |
| Grand total..... | 7,006 | 34,847,007 | 1,725,875 | 1,815,590 | 23,001,882 | 696,980 | 1,912,428 | 97,962 | 558,278 | 8,565 | 130,397 | 5,387 | |
| LANDED AT BOSTON. | | | | | | | | | | | | | |
| East of 66° W. longitude. | | | | | | | | | | | | | |
| By American vessels: | | | | | | | | | | | | | |
| La Have Bank..... | 756,080 | \$86,377 | | | | | | | | | | | |
| Western Bank..... | 1,540,445 | 66,615 | | | | | | | | | | | |
| LANDED AT BOSTON. | | | | | | | | | | | | | |
| East of 66° W. longitude. | | | | | | | | | | | | | |
| By American vessels: | | | | | | | | | | | | | |
| La Have Bank..... | 756,080 | \$86,377 | | | | | | | | | | | |
| Western Bank..... | 1,540,445 | 66,615 | | | | | | | | | | | |

Haddock.

Hake.

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

Large (over 2½ pounds).

Fishing grounds.

Small (under 6 pounds).

Large (6 pounds and over).

Scrod (1 to 2½ pounds).

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—(Continued.)

| Fishing grounds. | Haddock. | | | | Hake. | | | |
|---------------------------|-------------------------|-----------|-------------------------|--------|----------------------------|---------|-------------------------|---------|
| | Large (over 2½ pounds). | | Small (1 to 2½ pounds). | | Large (6 pounds and over). | | Small (under 6 pounds). | |
| | Fresh. | Salted. | Fresh. | Fresh. | Fresh. | Salted. | Fresh. | Salted. |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| LANDED AT PORTLAND. | | | | | | | | |
| East of 68° W. longitude. | | | | | | | | |
| By American vessels: | | | | | | | | |
| La Have Bank..... | 23,125 | \$531 | | | | | 1,790 | \$81 |
| Western Bank..... | | | | | | | 515 | 17 |
| Green Bank..... | 330 | 6 | | | | | 470 | 6 |
| Grand Bank..... | | | | | 10,190 | \$153 | | |
| St. Peters Bank..... | | | | | 255 | 10 | | |
| Off Newfoundland..... | | | | | 2,000 | 30 | | |
| Cape Shore..... | 28,260 | 1,324 | 4,320 | \$65 | 230 | 14 | | |
| The Gully..... | | | | | | | | |
| By Canadian vessels: | | | | | | | | |
| La Have Bank..... | 605 | 12 | | | 2,000 | 42 | | |
| Western Bank..... | 451,300 | 9,090 | | | | | 5,295 | 79 |
| West of 66° W. longitude. | | | | | | | | |
| By American vessels: | | | | | | | | |
| Georges Bank..... | 131,610 | 3,748 | | | 2,765 | 133 | 35,201 | \$89 |
| Cashes Bank..... | 555 | 18 | | | 29,931 | 1,001 | 232,315 | 5,375 |
| Platts Bank..... | 25,757 | 2,030 | 508 | 11 | | | 196,987 | 5,841 |
| Jeffreys' Ledge..... | 255,895 | 19,423 | 12,622 | 417 | 12,402 | 778 | | |
| South Channel..... | 394,598 | 9,861 | | | | | | |
| Shore, general..... | 575,651 | 35,592 | 9,357 | 280 | 58,839 | 2,471 | 569,423 | 14,873 |
| Total..... | 1,800,946 | 82,638 | 26,807 | 773 | 118,612 | 4,652 | 1,047,866 | 27,731 |
| Grand total..... | 74,983,615 | 2,734,785 | 251,419 | 3,929 | 1,683,302 | 59,136 | 2,982,820 | 93,306 |
| | | | 44,443 | 1,338 | 53,122 | 1,370 | 2,112 | 64 |

| Fishing grounds. | Pellock. | | | Cust. | | | Halibut. | | |
|--|-----------|---------|---------|---------|---------|---------|-----------|----------|---------|
| | Fresh. | | Salted. | Fresh. | | Salted. | Fresh. | | Salted. |
| | Pounds. | Value. | Pounds. | Pounds. | Value. | Pounds. | Pounds. | Value. | Pounds. |
| LANDED AT BOSTON. | | | | | | | | | |
| <i>East of 66° W. longitude.</i> | | | | | | | | | |
| By American vessels: | | | | | | | | | |
| La Have Bank..... | 30,695 | \$1,334 | | 79,745 | \$2,351 | | 83,766 | \$19,299 | |
| Western Bank..... | 89,210 | 4,131 | | 6,035 | 271 | | 213,968 | 40,500 | |
| Quequen Bank..... | 870 | 20 | | 6,880 | 52 | | 218,389 | 42,531 | |
| Green Bank..... | | | | | | | 96,701 | 19,773 | |
| Grand Bank..... | | | | 600 | 18 | | 271,785 | 50,431 | |
| St. Peters Bank..... | | | | | | | 108,163 | 19,906 | |
| Burgo Bank..... | 28,000 | 5,600 | | 3,430 | 59 | | 43,357 | 8,486 | |
| Cape Shore..... | 6,900 | 137 | | 1,000 | 20 | | 41,979 | 4,163 | \$150 |
| Rosway Bank..... | | | | 2,300 | 50 | | 219 | 63 | |
| By Canadian vessels: La Have Bank..... | 555 | 16 | | | | | 1,327 | 463 | |
| <i>West of 66° W. longitude.</i> | | | | | | | | | |
| By American vessels: | | | | | | | | | |
| Brown's Bank..... | 108,515 | 4,275 | | 133,105 | 4,257 | | 115,871 | 26,617 | |
| Georges Bank..... | 692,874 | 21,375 | | 91,790 | 2,906 | | 1,101,946 | 230,320 | |
| Cashes Bank..... | 4,240 | 167 | | 6,408 | 176 | | 1,185 | 329 | |
| Pippen's Bank..... | 8,365 | 246 | | 27,780 | 180 | | 31 | 10 | |
| Middle Bank..... | 80,600 | 3,154 | | 67,945 | 1,522 | | 3,193 | 981 | |
| Jeffrey's Ledge..... | 76,320 | 2,631 | | 75,730 | 2,340 | | 2,519 | 676 | |
| South Channel..... | 622,825 | 21,139 | | 138,385 | 2,069 | | 120,507 | 27,783 | |
| Nantucket Shoals..... | 19,127 | 612 | | 15 | 4 | | 4,343 | 1,110 | |
| Off Chatham..... | 339,084 | 9,299 | | 58,820 | 2,005 | | 36,153 | 8,760 | |
| Shore, general..... | 1,260,329 | 40,821 | | 38,000 | 1,101 | | 31,630 | 3,568 | 700 |
| By Canadian vessels: | | | | | | | | | |
| Brown's Bank..... | 38,060 | 1,018 | | 14,687 | 421 | | 2,017 | 566 | |
| Georges Bank..... | 12,885 | 156 | | 2,900 | 31 | | 1,290 | 298 | |
| Total..... | 3,337,074 | 122,431 | | 715,627 | 21,110 | | 2,300,552 | 496,615 | 1,150 |
| LANDED AT GLOUCESTER. | | | | | | | | | |
| <i>East of 66° W. longitude.</i> | | | | | | | | | |
| By American vessels: | | | | | | | | | |
| La Have Bank..... | 12,120 | 141 | | 166,515 | 2,769 | | 30,813 | 6,189 | 7 |
| Western Bank..... | 147,785 | 2,002 | | 174,020 | 5,389 | | 52,758 | 9,707 | 9 |
| Quequen Bank..... | 89,010 | 1,195 | | 28,380 | 601 | | 8,291 | 1,424 | 605 |
| Green Bank..... | 50 | 1 | | 4,365 | 89 | | 1,640 | 58 | 4,715 |
| Grand Bank..... | 1,085 | 14 | | 18,705 | 386 | | 1,035 | 27 | 2,596 |
| St. Peters Bank..... | | | | 22,565 | 370 | | 70 | 2 | 1,880 |
| Cape Shore..... | 600 | 8 | | | | | | | |
| The Gully..... | | | | 520 | 8 | | 185 | 6 | |
| By Canadian vessels: Quequen Bank..... | | | | | | | | | 400 |
| | | | | 3 | | | | | 48 |

| | Fishing grounds. | | | | | | Meekere. | | | | | |
|--------------------------------------|-------------------------|---------------------|--------------------|---------------------------|---------|--|--------------------------|---------|---------|--------|--------------------------|--|
| | Large (over 2½ pounds). | | | Medium (1½ to 2½ pounds). | | | Small (under 1½ pounds). | | | | | |
| | Fresh. | Salted. | | Fresh. | Salted. | | Fresh. | Salted. | | Fresh. | Salted. | |
| LANDED AT BOSTON. | | | | | | | | | | | | |
| East of 66° W. longitude. | | | | | | | | | | | | |
| By American vessels: Cape Shore..... | Pounds. 1,149,133 | Value. \$113,332 | Pounds. 130,200 | Value. \$15,454 | | | | | | | | |
| West of 66° W. longitude. | | | | | | | | | | | | |
| By American vessels: | | | | | | | | | | | | |
| Georges Bank..... | 67,148 | 15,474 | | 23,975 | \$3,403 | | | | 1,947 | \$496 | | |
| Middle Bank..... | 38,675 | 4,254 | | 37,075 | 3,988 | | | | 5,960 | 1,529 | | |
| South Channel..... | 1,117,230 | 93,037 | 27,400 | 2,331 | | | | | 3,500 | 385 | | |
| Nantucket Shoals..... | | 757 | | 633,315 | 67,329 | | | 1,800 | 63,030 | 8,832 | | |
| Off Chatham..... | 384,030 | 33,222 | 9,000 | 630 | | | | | 158,964 | 30,315 | | |
| Shore, general..... | 1,686,882 | 172,701 | 5,700 | 477 | | | | | 106,437 | 18,545 | | |
| Total..... | 1,444,495 | 431,466 | 222,300 | 18,892 | | | | | 339,738 | 60,102 | | |
| LANDED AT GLOUCESTER. | | | | | | | | | | | | |
| East of 66° W. longitude. | | | | | | | | | | | | |
| By American vessels: Cape Shore..... | 16,550 | 790 | 461,687 | 39,428 | | | | | | | | |
| West of 66° W. longitude. | | | | | | | | | | | | |
| By American vessels: | | | | | | | | | | | | |
| Georges Bank..... | 11,881 | 1,339 | 333 | 50 | | | | | | | | |
| Nantucket Shoals..... | 66,709 | 11,409 | 231,884 | 23,997 | | | | | 66,988 | 7,081 | 1,200 \$102 | |
| Shore, general..... | | | | | | | | | | | | |
| Total..... | 95,140 | 13,328 | 693,904 | 63,475 | | | | | 66,988 | 7,081 | 1,200 102 | |
| LANDED AT PORTLAND. | | | | | | | | | | | | |
| East of 66° W. longitude. | | | | | | | | | | | | |
| By American vessels: Cape Shore..... | 73,635 | 6,392 | 2,000 | 175 | | | | | | | | |
| West of 66° W. longitude. | | | | | | | | | | | | |
| By American vessels: | | | | | | | | | | | | |
| Georges Bank..... | 13,322 | 2,680 | | | | | | | | | | |
| Nantucket Shoals..... | 13,512 | 1,768 | | | | | | | | | | |
| Shore, general..... | | | | | | | | | | | | |
| Total..... | 100,489 | 10,849 | 2,000 | 175 | | | | | | | | |
| Grand total..... | 4,040,124 | 455,853 | 918,204 | 82,542 | | | | | 89,788 | 9,110 | 310,823 60,171 1,200 102 | |

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

| Fishing grounds. | Miscellaneous. | | Total. | | Grand total. | |
|--|------------------|-----------------|----------------------|---------------------|----------------------|---------------------|
| | Fresh. | Salted. | Fresh. | Salted. | | |
| LANDED AT BOSTON. | | | | | | |
| East of 66° W. longitude. | | | | | | |
| By American vessels: | | | | | | |
| La Have Bank..... | Pounds. 7,919 | Value. \$736 | Pounds. 2,420,656 | Value. \$137,755 | Pounds. 2,420,656 | Value. \$137,755 |
| Western Bank..... | 10,227 | 1,158 | 3,432,480 | 192,483 | 3,432,480 | 192,483 |
| Queveau Bank..... | 328 | 85 | 270,907 | 44,523 | 270,907 | 44,523 |
| Green Bank..... | 250 | 100 | 96,951 | 19,873 | 96,951 | 19,873 |
| Grand Bank..... | 120 | 30 | 323,305 | 52,922 | 323,305 | 52,922 |
| St. Peters Bank..... | | | 127,198 | 29,656 | 127,198 | 29,656 |
| Burgoon Bank..... | | | 71,357 | 14,086 | 71,357 | 14,086 |
| Cape North..... | | | 66,050 | 3,068 | 66,050 | 3,068 |
| Cape Shore..... | | | 1,458,165 | 130,771 | 1,458,165 | 130,771 |
| Roseway Bank..... | 11,818 | 1,980 | 13,999 | 295,269 | 13,999 | 295,269 |
| By Canadian vessels: La Have Bank..... | | | 111,262 | 5,500 | 111,262 | 5,500 |
| West of 66° W. longitude. | | | | | | |
| By American vessels: | | | | | | |
| Browns Bank..... | 103,227 | 5,029 | 4,444,717 | 223,397 | 4,444,717 | 223,397 |
| Georges Bank..... | 2,419,339 | 431,268 | 40,112,036 | 2,342,129 | 40,112,036 | 2,342,129 |
| Cashes Bank..... | | | 46,488 | 2,349 | 46,488 | 2,349 |
| Finnepies Bank..... | 39,863 | 8 | 142,404 | 7,563 | 142,404 | 7,563 |
| Middle Bank..... | 14,362 | 2,700 | 924,753 | 55,635 | 924,753 | 55,635 |
| Jeffrey's Ledge..... | 831,360 | 47,810 | 764,350 | 40,913 | 764,350 | 40,913 |
| South Channel..... | 65,652 | 3,068 | 43,043,073 | 1,635,478 | 43,043,073 | 1,635,478 |
| Nantuxet Shoals..... | 235,264 | 13,634 | 3,467,976 | 238,269 | 3,467,976 | 238,269 |
| Off Chatham..... | | | 6,929,627 | 349,702 | 6,929,627 | 349,702 |
| South..... | 3,015,563 | 125,144 | 384,630 | 32,222 | 384,630 | 32,222 |
| Shore, general..... | | | 8,450,846 | 507,896 | 8,450,846 | 507,896 |
| By Canadian vessels: | | | | | | |
| Browns Bank..... | 31,814 | 3,305 | 776,292 | 29,284 | 776,292 | 29,284 |
| Georges Bank..... | 90,056 | 14,253 | 421,220 | 27,363 | 421,220 | 27,363 |
| Total..... | 6,927,831 | 655,327 | 118,301,802 | 6,114,403 | 118,553,902 | 6,136,569 |

LANDED AT GLOUCESTER.

East of 68° W. longitude.

By American vessels:

| | | | | | |
|---------------------------------------|-----------|-----------|---------|------------|---------|
| La Have Bank..... | 27,450 | 44,064 | 2,370 | 1,031,737 | 20,830 |
| Western Bank..... | 231,419 | 612,865 | 35,340 | 9,396,261 | 260,759 |
| Green Bank..... | 297,713 | 2,103,664 | 107,371 | 10,455,999 | 315,085 |
| Grand Bank..... | 2,950 | 74,331 | 4,152 | 185,781 | 7,108 |
| St. Peter's Bank..... | 17,147 | 408,885 | 26,461 | 1,083,953 | 43,608 |
| Off Newfoundland..... | 11,180 | 5,785 | 341 | 416,900 | 11,550 |
| Cape Shore..... | 3,097,024 | \$10,157 | 110,157 | 3,097,024 | 110,157 |
| The Gully..... | 5,019 | 461,087 | 39,428 | 631,887 | 44,447 |
| By Canadian vessels: Quebec Bank..... | 827 | 21,750 | 976 | 45,100 | 1,803 |
| | 23,330 | 271,580 | 13,006 | 271,580 | 13,006 |

West of 68° W. longitude.

By American vessels:

| | | | | | |
|-----------------------|------------|-----------|---------|------------|-----------|
| Brown's Bank..... | 18,578 | 770,325 | ..... | 770,325 | 18,578 |
| Georges Bank..... | 167,562 | 1,067,562 | 6,506 | 7,300,283 | 173,068 |
| Jeffrey's Ledge..... | 36,410 | 127,775 | ..... | 36,410 | 575 |
| Powder Bay..... | 36,680 | ..... | ..... | 26,000 | 406 |
| South Channel..... | 3,044,901 | 45,471 | ..... | 3,044,901 | 45,471 |
| Northeast Shoals..... | 172,841 | 6,840 | ..... | 3,472,453 | 38,010 |
| Seal Island..... | 173,45 | 300,072 | 31,180 | 215,430 | 6,362 |
| Shore, general..... | 8,298,877 | 37,735 | 1,805 | 8,259,472 | 332,873 |
| | 332,857 | 595 | 46 | ..... | ..... |
| Total..... | 3,9112,953 | 7,027,343 | 379,750 | 46,740,296 | 1,460,336 |

LANDED AT PORTLAND.

East of 68° W. longitude.

By American vessels:

| | | | | | |
|-----------------------|--------|-------|-------|---------|--------|
| La Have Bank..... | 300 | 75 | ..... | 116,022 | 13,834 |
| Western Bank..... | ..... | ..... | ..... | 172,997 | 29,867 |
| Green Bank..... | 310 | 78 | ..... | 104,795 | 29,173 |
| Grand Bank..... | ..... | ..... | ..... | 69,403 | 11,739 |
| St. Peter's Bank..... | 451 | 75 | ..... | 334,356 | 53,251 |
| Off Newfoundland..... | ..... | ..... | ..... | 163,750 | 34,049 |
| Cape Shore..... | 40,584 | 8,800 | ..... | 15,225 | 2,150 |
| The Gully..... | ..... | ..... | ..... | 2,600 | 18,996 |
| By Canadian vessels: | ..... | ..... | ..... | 218,571 | 17,766 |
| La Have Bank..... | ..... | ..... | ..... | 84,504 | ..... |
| Western Bank..... | ..... | ..... | ..... | 6,775 | 9,739 |
|  | ..... | ..... | ..... | 290,907 | 22,381 |

¹ Herring. Other items under "Miscellaneous" include bluebacks, 31,650 pounds, value \$520; butterfish, 13,087 pounds, value \$2,501; flounders, 3,637,774 pounds, value \$166,895; herring, 3,900,960 pounds, value \$56,144; rosefish, 67,613 pounds, value \$2,000; shad, 115,792 pounds, value \$6,322; sharks, 15,262 pounds, value \$105; skates, 4,425 pounds, value \$98; smelt, 10,449 pounds, value \$1,216; sturgeon, 3,301 pounds, value \$300; swordfish, 2,531,669 pounds, value \$494,202; tuna, 12,001 pounds, value \$944; whiting, 800 pounds, value \$41; wolfish, 170,729 pounds, value \$4,926; squid, 1,880 pounds, value \$36; lobster, 100 pounds, value \$83; livers, 772,329 pounds, value \$24,715; sounds, 6,383 pounds, value, \$320; and: spawn, 121,776 pounds, value \$8,167.

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

| Fishing grounds. | Miscellaneous. | | | | Total. | | Grand total. |
|--|----------------|---------|-----------|---------|-------------|-----------|--------------|
| | Fresh. | | Salted. | | Fresh. | Salted. | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | |
| LANDED AT PORTLAND—continued. | | | | | | | |
| West of 66° W. longitude. | | | | | | | |
| By American vessels: | | | | | | | |
| Brown's Bank..... | 10,466 | \$2,198 | | | 10,466 | | |
| Georges Bank..... | 122,235 | 22,273 | | | 340,770 | | 10,466 |
| Cashes Bank..... | 350 | 8 | | | 138,587 | | 38,883 |
| Platts Bank..... | 10,713 | 232 | | | 623,218 | | 138,587 |
| Jeffreys Ledge..... | 21,137 | 804 | | | 22,476 | | 633,218 |
| South Channel..... | 265 | 13 | | | 678,298 | | 35,344 |
| Shore, general..... | 4,031,781 | 62,415 | | | 386,947 | | 9,930 |
| By Canadian vessels: Georges Bank..... | 73,585 | 11,155 | | | 265,670 | \$338 | 396,947 |
| Total..... | 4,302,180 | 108,186 | | | 11,532 | | 8,496,670 |
| Grand total..... | 11,418,571 | 770,178 | 3,097,024 | 110,157 | 12,752,254 | 617,772 | 12,981,503 |
| | | | | | 170,167,000 | 7,842,817 | 178,280,701 |
| | | | | | | | 8,227,013 |

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920.¹

| Month. | Number of trips. | Cod. | | | | | |
|-------------------|------------------|-----------------------------|----------|---------------------------------------|----------|-------------------------|---------|
| | | Large (10 pounds and over). | | Market (under 10 and over 2½ pounds). | | Scrod (1 to 2½ pounds). | |
| | | Fresh. | Salted. | Fresh. | Salted. | Fresh. | Salted. |
| | | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| LANDED AT BOSTON. | | | | | | | |
| January..... | 209 | 947,700 | \$83,987 | 716,380 | \$37,070 | 40,355 | \$901 |
| February..... | 195 | 2,075,600 | 164,798 | 547,332 | 29,240 | 6,895 | 170 |
| March..... | 315 | 3,333,703 | 182,451 | 906,045 | 36,193 | 5,455 | 127 |
| April..... | 214 | 1,353,829 | 69,337 | 617,078 | 21,289 | 16,090 | 267 |
| May..... | 254 | 1,565,234 | 71,246 | 1,030,387 | 33,451 | 24,885 | 368 |
| June..... | 271 | 1,570,550 | 89,377 | 1,299,085 | 41,024 | 8,760 | 125 |

| | | | | | | | |
|----------------|-------|------------|-----------|------------|---------|---------|-------|
| July..... | 311 | 1,363,398 | 74,121 | 1,371,48 | 39,663 | 5,020 | 63 |
| August..... | 335 | 1,746,160 | 90,215 | 1,393,327 | 40,710 | 4,480 | 45 |
| September..... | 344 | 1,318,365 | 92,425 | 1,136,311 | 38,364 | 19,180 | 264 |
| October..... | 289 | 1,582,428 | 92,570 | 1,091,218 | 33,569 | 11,505 | 123 |
| November..... | 329 | 1,147,438 | 94,260 | 983,322 | 40,537 | 51,530 | 702 |
| December..... | 253 | 769,167 | 62,916 | 739,195 | 32,155 | 71,530 | 1,239 |
| Total..... | 3,342 | 19,004,092 | 1,177,813 | 12,007,699 | 423,265 | 268,715 | 4,395 |

| | | | | | | | |
|-----------------------|-------|------------|---------|------------|---------|---------|-------|
| LANDED AT GLoucester. | | | | | | | |
| January..... | 194 | 296,995 | 13,722 | 18,645 | 492 | 3,305 | 46 |
| February..... | 112 | 194,300 | 10,712 | 112,239 | 239 | 85 | 2 |
| March..... | 332 | 1,085,210 | 41,214 | 112,239 | 3,145 | 843 | 8 |
| April..... | 442 | 2,375,329 | 80,192 | 635,775 | 17,124 | 5,130 | 98 |
| May..... | 286 | 2,790,765 | 83,620 | 1,815,325 | 46,732 | 19,130 | 286 |
| June..... | 469 | 2,294,892 | 69,458 | 1,815,325 | 33,186 | 10,895 | 610 |
| July..... | 460 | 2,218,920 | 68,060 | 2,178,833 | 52,034 | 10,895 | 126 |
| August..... | 78 | 1,583,575 | 41,318 | 2,353,894 | 42,661 | 20,241 | 250 |
| September..... | 83 | 314,483 | 15,362 | 1,918,280 | 137,885 | 8,830 | 110 |
| October..... | 211 | 194,915 | 14,250 | 698,131 | 17,213 | 26,919 | 133 |
| November..... | 221 | 188,285 | 9,667 | 418,285 | 9,675 | 7,705 | 28 |
| December..... | 228 | 229,195 | 9,657 | 182,285 | 2,649 | 3,175 | 814 |
| Total..... | 2,381 | 14,086,065 | 422,203 | 10,469,452 | 251,643 | 133,874 | 1,692 |

| | | | | | | | |
|---------------------|-------|-----------|--------|---------|--------|---------|-------|
| LANDED AT PORTLAND. | | | | | | | |
| January..... | 90 | 48,271 | 4,364 | 53,181 | 2,907 | 18,132 | 439 |
| February..... | 59 | 64,755 | 5,039 | 21,917 | 1,632 | 4,899 | 170 |
| March..... | 172 | 104,225 | 6,253 | 58,903 | 2,530 | 7,696 | 192 |
| April..... | 234 | 243,170 | 19,287 | 127,173 | 3,685 | 7,454 | 111 |
| May..... | 234 | 193,011 | 4,405 | 57,298 | 1,587 | 5,378 | 73 |
| June..... | 377 | 255,766 | 5,540 | 27,632 | 45 | 3,829 | 51 |
| July..... | 154 | 202,088 | 15,011 | 43,816 | 1,184 | 1,668 | 23 |
| August..... | 133 | 254,124 | 11,366 | 21,801 | 691 | 3,877 | 42 |
| September..... | 115 | 108,584 | 5,898 | 38,284 | 1,285 | 12,701 | 445 |
| October..... | 130 | 128,637 | 6,269 | 38,975 | 1,195 | 11,166 | 116 |
| November..... | 110 | 64,811 | 5,323 | 37,529 | 1,848 | 19,178 | 202 |
| December..... | 77 | 58,498 | 5,123 | 58,312 | 2,551 | 59,681 | 611 |
| Total..... | 1,883 | 1,736,830 | 95,839 | 784,731 | 22,072 | 155,689 | 2,478 |

| | | | | | | | |
|-----------------------------------|-------|------------|-----------|------------|---------|---------|-------|
| Grand total..... | | | | | | | |
| Grounds east of 66° W. long..... | 7,093 | 34,817,007 | 1,725,875 | 23,001,882 | 696,980 | 558,278 | 8,565 |
| Grounds west of 66° W. long..... | 520 | 11,427,557 | 400,001 | 8,712,255 | 224,018 | 115,885 | 1,591 |
| Landed at Boston in 1919..... | 7,083 | 33,419,450 | 1,325,784 | 21,289,557 | 472,992 | 442,393 | 6,984 |
| Landed at Gloucester in 1919..... | 2,754 | 20,134,289 | 1,033,289 | 9,038,012 | 331,194 | 385,344 | 7,788 |
| Landed at Portland in 1919..... | 2,963 | 18,208,512 | 667,307 | 8,016,905 | 220,526 | 137,801 | 2,202 |
| Landed at Portland in 1919..... | 2,530 | 2,836,747 | 131,202 | 874,935 | 51,644 | 98,416 | 2,691 |

¹ The above statistics for the year 1920 include 54 trips landed by Canadian fishing vessels, 43 at Boston, 1 at Gloucester, and 10 at Portland, amounting to 2,588,218 pounds of fish, value \$119,028.

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920.—Continued.

| Month. | Haddock. | | | | Hake. | | | |
|-----------------------|-------------------------|-----------|-------------------------|--------|----------------------------|--------|------------------------|---------|
| | Large (over 2½ pounds). | | Scrod (1 to 2½ pounds). | | Large (5 pounds and over). | | Small (under 6 pound). | |
| | Fresh. | | Salted. | | Fresh. | | Salted. | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| LANDED AT BOSTON. | | | | | | | | |
| January..... | 5,996,213 | \$330,008 | 4,800 | \$175 | 13,163 | \$898 | 31,241 | \$2,770 |
| February..... | 6,214,746 | 309,801 | 645 | 15 | 11,759 | 1,264 | 9,415 | 828 |
| March..... | 8,910,530 | 302,420 | 17,980 | 437 | 17,940 | 1,145 | 17,200 | 1,033 |
| April..... | 4,531,355 | 165,729 | 4,075 | 90 | 15,160 | 738 | 16,680 | 693 |
| May..... | 5,099,480 | 181,700 | 2,260 | 23 | 24,795 | 1,156 | 65,135 | 2,353 |
| June..... | 4,412,980 | 150,987 | 290 | 6 | 33,070 | 1,629 | 79,020 | 2,803 |
| July..... | 3,677,270 | 120,113 | 100 | 2 | 30,880 | 1,114 | 220,315 | 5,282 |
| August..... | 4,658,175 | 121,035 | | | 93,845 | 3,016 | 230,554 | 7,914 |
| September..... | 5,780,368 | 144,946 | | | 59,370 | 2,600 | 269,255 | 11,070 |
| October..... | 6,037,915 | 154,611 | | | 279,074 | 7,561 | 302,385 | 7,125 |
| November..... | 4,756,689 | 246,401 | | | 200,990 | 7,784 | 409,024 | 13,267 |
| December..... | 4,614,717 | 248,305 | 1,300 | 24 | 34,404 | 2,650 | 233,670 | 10,437 |
| Total..... | 64,720,438 | 2,476,056 | 31,450 | 772 | 814,450 | 31,575 | 1,924,954 | 65,375 |
| LANDED AT GLOUCESTER. | | | | | | | | |
| January..... | 80,275 | 4,318 | | | 24,290 | 1,344 | | |
| February..... | 235,675 | 14,056 | | | 10,085 | 1,026 | | |
| March..... | 1,331,725 | 35,737 | | | 15,785 | 1,159 | | |
| April..... | 1,470,680 | 49,157 | 890 | \$32 | 17,820 | 1,059 | | |
| May..... | 944,050 | 19,230 | 166,515 | 2,082 | 48,890 | 795 | | |
| June..... | 1,159,150 | 16,873 | 19,807 | 231 | 27,990 | 420 | | |
| July..... | 348,631 | 4,957 | 50 | 1 | 76,773 | 1,276 | 2,052 | 51 |
| August..... | 839,590 | 9,150 | 18,740 | 562 | 138,800 | 2,081 | 2,370 | 67 |
| September..... | 1,384,910 | 13,801 | 6,810 | 51 | 88,475 | 1,869 | 1,440 | 43 |
| October..... | 491,095 | 4,844 | | | 88,990 | 1,558 | 10,235 | 233 |
| November..... | 26,895 | 717 | | | 22,135 | 611 | 27,135 | 611 |
| December..... | 62,555 | 3,221 | 1,145 | 34 | 64,265 | 2,125 | 8,160 | 200 |
| Total..... | 8,372,231 | 176,091 | 193,162 | 2,384 | 148,075 | 8,197 | 4,460 | 112 |
| | | | 854 | | 51,182 | 1,321 | | |
| Total..... | | | 28,300 | | 750,240 | 22,909 | 455 | |

LANDED AT PORTLAND.

| LANDED AT PORTLAND. | | | | | | | | | |
|-------------------------------|------------|-----------|-----------|---------|-----------|--------|-----------|--------|----|
| January | 102,880 | 8,385 | 2,967 | 111 | 2,109 | 164 | 12,916 | 715 | |
| February | 197,555 | 11,467 | 6,165 | 360 | 2,573 | 238 | 1,755 | | |
| March | 158,869 | 11,533 | 5,515 | 164 | 718 | 615 | 3,936 | | |
| April | 268,353 | 13,041 | 6,471 | 100 | 14,060 | 736 | 75,713 | 4,633 | |
| May | 181,000 | 6,088 | 4,471 | 46 | 20,781 | 553 | 1,940 | 49 | |
| June | 15,234 | 1,167 | 456 | 10 | 20,781 | 245 | 67,471 | 3,677 | |
| July | 8,046 | 281 | 99 | 6 | 6,419 | 466 | 62,453 | 1,305 | |
| August | 82,479 | 19,119 | 99 | 6 | 6,419 | 466 | 67,488 | 1,235 | 10 |
| September | 6,611 | 265 | 7 | 7 | 6,582 | 173 | 36,179 | 624 | 43 |
| October | 19,710 | 849 | 485 | 11 | 2,211 | 79 | 16,232 | 2,009 | |
| November | 57,331 | 4,031 | 1,385 | 35 | 25,770 | 484 | 157,109 | 3,589 | |
| December | 80,948 | 6,271 | 3,343 | 8 | 5,267 | 498 | 188,161 | 3,034 | |
| Total | 1,800,946 | 82,608 | 26,807 | 773 | 118,612 | 4,652 | 1,017,806 | 27,731 | 55 |
| Grand total | 74,983,615 | 5,734,785 | 2,514,419 | 3,429 | 1,684,202 | 39,136 | 2,982,820 | 43,306 | 61 |
| Grounds east of 66° W. long. | 4,424,836 | 113,532 | 44,443 | 1,338 | 395,720 | 6,334 | 64,240 | 2,346 | 51 |
| Grounds west of 66° W. long. | 70,358,779 | 2,341,233 | 3,171,782 | 3,196 | 32,002 | 6,200 | 2,918,500 | 40,960 | 10 |
| Landed at Boston in 1919. | 25,338,154 | 2,201,254 | 70,886 | 39,706 | 1,497,928 | 64,720 | 1,407,928 | 64,720 | |
| Landed at Gloucester in 1919. | 17,150,877 | 336,149 | 6,718 | 704,007 | 24,130 | 33,070 | 1,269 | 500 | 8 |
| Landed at Portland in 1919. | 6,954,704 | 195,183 | 69,257 | 1,011 | 188,887 | 11,934 | 1,058,165 | 39,271 | 15 |

Month.

Followers.

Crink.

Halibut.

[illegible]

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920—Continued.

| Month. | Portland. | | | Cusk. | | | Halibut. | | |
|-------------------------------|------------|----------|---------|-----------|---------|---------|-----------|---------|---------|
| | Fresh. | | Salted. | Fresh. | | Salted. | Fresh. | | Salted. |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. |
| LANDED AT GLOUCESTER. | | | | | | | | | |
| January..... | 373,151 | \$23,327 | | 4,905 | \$123 | | 622 | \$152 | |
| February..... | 37,780 | 3,619 | | 1,895 | 23 | | 23,370 | 4,173 | |
| March..... | 46,040 | 3,401 | | 1,525 | 35 | | | | |
| April..... | 63,063 | 3,971 | | 10,100 | 205 | | 23,178 | 4,741 | 75 |
| May..... | 78,030 | 1,754 | | 58,360 | 1,117 | | 20,675 | 2,895 | 65 |
| June..... | 107,490 | 1,465 | 200 | 10,305 | 3,222 | | 8,401 | 1,448 | 2,985 |
| July..... | 52,875 | 717 | 140 | 106,700 | 3,454 | 1,891 | | | 7 |
| August..... | 23,530 | 430 | 2,485 | 154,781 | 3,044 | 315 | | | 284 |
| September..... | 140,140 | 2,280 | 8,735 | 64,410 | 1,216 | 962 | | | 354 |
| October..... | 1,191,897 | 14,927 | 1,780 | 95,659 | 1,222 | 74 | | | 332 |
| November..... | 1,004,959 | 25,739 | 3,220 | 12,410 | 220 | 2,000 | 30,843 | 6,189 | 575 |
| December..... | 1,053,775 | 36,922 | 6 | 18,180 | 300 | 185 | | | 69 |
| Total..... | 4,183,783 | 118,392 | 16,780 | 598,236 | 11,271 | 5,353 | 107,089 | 19,598 | 9,746 |
| LANDED AT PORTLAND. | | | | | | | | | |
| January..... | 3,077 | 161 | | 19,566 | 1,333 | | 33,149 | 7,194 | |
| February..... | 3,123 | 229 | | 12,937 | 998 | | 53,998 | 10,710 | |
| March..... | 8,097 | 526 | | 50,200 | 2,665 | | 84,218 | 15,989 | |
| April..... | 22,150 | 1,123 | | 94,281 | 2,334 | | 105,674 | 24,230 | |
| May..... | 85,302 | 2,879 | | 71,690 | 1,379 | | 135,961 | 25,369 | |
| June..... | 429,608 | 5,699 | | 13,202 | 458 | | 117,021 | 18,397 | |
| July..... | 31,650 | 609 | | 39,971 | 1,046 | | 136,547 | 25,092 | |
| August..... | 38,031 | 775 | 2,370 | 28,507 | 1,645 | | 91,639 | 18,788 | |
| September..... | 168,325 | 4,140 | 2,770 | 8,383 | 366 | | 101,163 | 21,506 | |
| October..... | 126,355 | 2,090 | 83 | 51,243 | 1,132 | 8 | 122,120 | 22,654 | |
| November..... | 68,460 | 1,263 | 115 | 73,277 | 1,660 | | 133,455 | 32,230 | |
| December..... | 33,869 | 970 | | 43,012 | 1,235 | | 5,028 | 1,024 | |
| Total..... | 1,018,007 | 29,472 | 5,255 | 505,269 | 15,451 | 260 | 1,139,973 | 223,223 | |
| Grand total..... | 8,538,806 | 261,485 | 22,035 | 1,840,126 | 47,822 | 5,613 | 3,707,594 | 739,436 | 2,385 |
| Grounds east of 66° W. long. | | | | | | | | | |
| Grounds west of 66° W. long. | 471,950 | 16,090 | 18,560 | 598,250 | 11,325 | 4,426 | 2,147,616 | 411,365 | 1,685 |
| Landed at Boston in 1919. | 8,000,781 | 245,395 | 3,475 | 1,280,873 | 36,507 | 1,187 | 1,619,978 | 328,071 | 7,000 |
| Landed at Gloucester in 1919. | 14,508,786 | 105,036 | | 736,654 | 22,986 | | 1,329,384 | 250,112 | 2,000 |
| Landed at Portland in 1919. | 248,205 | 248,205 | 55,101 | 698,957 | 13,373 | 37,962 | 1,337,460 | 54,820 | 12,600 |
| Landed at Portland in 1919. | 1,096,784 | 25,889 | 515 | 679,625 | 24,152 | | 413,217 | 80,169 | |

Mackerel.

| Month. | Large (over 2½ pounds). | | | | Medium (1½ to 2½ pounds). | | | | Small (under 1½ pounds). | | | |
|-------------------------------|-------------------------|-----------|-----------|---------|---------------------------|----------|---------|---------|--------------------------|---------|---------|--------|
| | Fresh. | | Salted. | | Fresh. | | Salted. | | Fresh. | | Salted. | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| LANDED AT BOSTON. | | | | | | | | | | | | |
| May..... | 1,311,600 | \$119,557 | 9,000 | \$830 | 310,350 | \$23,217 | 21,000 | \$1,870 | 24,190 | \$1,283 | | |
| June..... | 2,323,085 | 203,703 | 197,703 | 16,924 | 625,900 | 71,262 | 1,800 | 189 | 61,190 | 10,410 | | |
| July..... | 514,385 | 50,735 | 15,600 | 1,328 | 119,827 | 21,626 | | | 65,837 | 12,028 | | |
| August..... | 32,244 | 7,175 | | | 56,600 | 11,717 | | | 179,601 | 34,852 | | |
| September..... | 42,255 | 11,214 | | | | | | | 5,960 | 1,529 | | |
| October..... | 36,465 | 6,915 | | | 108,260 | 19,109 | | | | | | |
| November..... | 178,200 | 50,920 | | | 3,790 | 1,045 | | | | | | |
| December..... | 6,180 | 1,725 | | | | | | | | | | |
| Total..... | 4,444,465 | 431,466 | 222,300 | 18,892 | 1,224,657 | 117,976 | 22,800 | 2,030 | 339,738 | 60,102 | | |
| LANDED AT GLOUCESTER. | | | | | | | | | | | | |
| June..... | 16,550 | 790 | 461,657 | 39,428 | 45,260 | 7,963 | 65,800 | 6,952 | | | 1,200 | \$102 |
| July..... | 10,801 | 1,080 | 290,084 | 23,779 | 1,400 | 280 | | 88 | | | | |
| August..... | | | 1,800 | 218 | 8,485 | 1,418 | 388 | 41 | | | | |
| September..... | 13,604 | 2,908 | 335 | 30 | | | | | | | | |
| October..... | 51,098 | 8,760 | | | | | | | | | | |
| November..... | 95,140 | 13,538 | 693,994 | 63,475 | 55,145 | 3,991 | 66,988 | 7,681 | | | 1,200 | 102 |
| Total..... | | | | | | | | | | | | |
| LANDED AT PORTLAND. | | | | | | | | | | | | |
| June..... | 82,259 | 7,249 | 2,000 | 175 | 3,515 | 400 | | | | | | |
| July..... | 12,146 | 2,045 | | | 1,466 | 183 | | | | | | |
| August..... | 1,797 | 419 | | | 1,417 | 116 | | | 410 | 6 | | |
| September..... | 3,512 | 940 | | | | | | | 125 | 8 | | |
| October..... | | | | | 17,352 | 2,620 | | | 550 | 55 | | |
| November..... | 855 | 195 | | | | | | | | | | |
| Total..... | 100,480 | 10,849 | 2,000 | 175 | 29,770 | 3,319 | | | 1,085 | 69 | | |
| Grand total..... | 4,640,124 | 455,885 | 918,204 | 82,512 | 1,305,382 | 155,290 | 89,788 | 9,140 | 340,823 | 60,171 | 1,200 | 102 |
| Grounds east of 66° W. long. | | | | | | | | | | | | |
| Grounds west of 66° W. long. | 1,240,328 | 120,714 | 618,887 | 53,657 | 1,303,352 | 155,285 | 20,000 | 1,800 | 340,823 | 60,171 | 1,200 | 102 |
| Landed at Boston in 1919. | 3,400,796 | 335,139 | 274,317 | 27,485 | 179,125 | 13,899 | 69,788 | 7,340 | 1,063,778 | 108,019 | 5,200 | 442 |
| Landed at Gloucester in 1919. | 2,621,081 | 237,712 | 166,000 | 13,556 | | | | | 21,898 | 888 | 34,288 | 2,538 |
| Landed at Portland in 1919. | 221,129 | 34,211 | 1,183,959 | 102,224 | 1,035 | 98 | 6,400 | 950 | 5,874 | 955 | 20 | 2 |
| Landed at Gloucester in 1919. | 188,650 | 29,881 | 4,559 | 427 | 12,800 | 1,461 | | | | | | |

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND
PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920—Continued.

| Month. | Miscellaneous. ² | | | | Total. | | | |
|-----------------------|-----------------------------|----------|---------|--------|-------------|-----------|-----------|---------|
| | Fresh. | | Salted. | | Fresh. | | Salted. | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| LANDED AT BOSTON. | | | | | | | | |
| January..... | 289,732 | \$17,499 | ..... | ..... | 8,232,028 | \$496,331 | ..... | ..... |
| February..... | 577,747 | 21,069 | ..... | ..... | 9,371,367 | 550,029 | ..... | ..... |
| March..... | 578,038 | 30,369 | ..... | ..... | 13,949,484 | 581,843 | ..... | ..... |
| April..... | 462,526 | 17,546 | ..... | ..... | 7,384,439 | 334,866 | ..... | ..... |
| May..... | 365,681 | 9,892 | ..... | ..... | 10,183,406 | 512,466 | ..... | ..... |
| June..... | 259,563 | 14,907 | ..... | ..... | 10,987,550 | 603,217 | ..... | ..... |
| July..... | 1,115,278 | 174,053 | ..... | ..... | 9,543,969 | 612,832 | ..... | ..... |
| August..... | 1,345,219 | 202,010 | ..... | ..... | 10,761,148 | 593,653 | ..... | ..... |
| September..... | 756,437 | 101,583 | ..... | ..... | 10,629,401 | 518,125 | ..... | ..... |
| October..... | 475,278 | 18,999 | ..... | ..... | 10,702,840 | 380,687 | ..... | ..... |
| November..... | 366,873 | 17,705 | ..... | ..... | 8,959,932 | 514,571 | ..... | ..... |
| December..... | 525,459 | 29,585 | ..... | ..... | 7,592,808 | 415,838 | ..... | ..... |
| Total..... | 6,927,851 | 655,327 | ..... | ..... | 118,201,802 | 6,114,468 | 257,100 | 22,101 |
| LANDED AT GLOUCESTER. | | | | | | | | |
| January..... | 61,856 | 3,346 | ..... | ..... | 773,887 | 46,870 | ..... | ..... |
| February..... | 36,300 | 2,110 | ..... | ..... | 506,615 | 36,010 | ..... | ..... |
| March..... | ..... | ..... | ..... | ..... | 2,623,840 | 81,999 | ..... | ..... |
| April..... | ..... | ..... | ..... | ..... | 151,766 | 107,417 | ..... | ..... |
| May..... | ..... | ..... | ..... | ..... | 5,923,508 | 160,417 | ..... | ..... |
| June..... | ..... | ..... | ..... | ..... | 5,887,500 | 146,170 | ..... | ..... |
| July..... | ..... | ..... | ..... | ..... | 5,164,781 | 134,003 | ..... | ..... |
| August..... | 26,600 | 466 | ..... | ..... | 4,721,138 | 100,837 | ..... | ..... |
| September..... | 3,784 | 743 | ..... | ..... | 2,910,488 | 54,103 | ..... | ..... |
| October..... | ..... | ..... | ..... | ..... | 2,802,777 | 49,517 | ..... | ..... |
| November..... | ..... | ..... | ..... | ..... | 1,567,455 | 54,881 | ..... | ..... |
| December..... | ..... | ..... | ..... | ..... | 1,630,484 | 60,974 | ..... | ..... |
| Total..... | 128,540 | 6,665 | ..... | ..... | 39,112,953 | 1,080,577 | 7,027,343 | 379,759 |
| LANDED AT PORTLAND. | | | | | | | | |
| January..... | 10,033 | 378 | ..... | ..... | 306,281 | 26,442 | ..... | ..... |
| February..... | 16,080 | 668 | ..... | ..... | 318,098 | 33,186 | ..... | ..... |
| March..... | 18,041 | 599 | ..... | ..... | 579,816 | 48,025 | ..... | ..... |
| April..... | 14,678 | 408 | ..... | ..... | 1,049,796 | 60,728 | ..... | ..... |
| May..... | 329,163 | 5,031 | ..... | ..... | 1,269,835 | 55,273 | ..... | ..... |
| June..... | 3,132,993 | 47,778 | ..... | ..... | 4,122,792 | 96,115 | ..... | ..... |
| Total..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Grand total. | | | | | | | | |

| | | | | | | | | | |
|--|------------|---------|---------|-------------|-----------|-----------|---------|-------------|-----------|
| July | 133,405 | 23,439 | | 752,182 | 70,661 | 1,957 | 132 | 754,339 | 70,793 |
| August | 132,102 | 15,125 | | 1,499,123 | 67,805 | 6,775 | 332 | 1,476,198 | 68,228 |
| September | 311,132 | 11,825 | | 778,088 | 17,309 | 210,097 | 11,216 | 1,089,085 | 58,546 |
| October | 239,828 | 2,692 | | 920,878 | 39,569 | 205 | 7 | 921,083 | 39,576 |
| November | 15,465 | 687 | | 706,191 | 31,215 | | | 705,604 | 51,205 |
| December | 6,161 | 152 | | 448,261 | 21,370 | | | 448,261 | 21,370 |
| Total | 4,302,180 | 108,186 | | 12,792,351 | 617,772 | 229,219 | 12,336 | 12,981,593 | 630,108 |
| Grand total | 11,418,571 | 770,178 | 110,157 | 170,167,009 | 7,812,817 | 8,113,692 | 411,196 | 178,280,701 | 8,227,013 |
| Grounds east of 66° W. long. | 72,377 | 13,177 | 110,157 | 29,813,631 | 1,351,226 | 7,381,083 | 369,601 | 37,427,711 | 1,720,830 |
| Grounds west of 66° W. long. | 11,346,194 | 757,091 | | 140,523,378 | 6,461,591 | 529,609 | 41,332 | 140,852,987 | 6,506,183 |
| Landed at Boston in 1919 | 1,565,511 | 390,018 | 285 | 103,208,770 | 4,698,717 | 182,600 | 11,603 | 103,391,370 | 5,713,350 |
| Landed at Gloucester in 1919 | 113,800 | 9,415 | 189,783 | 61,621,587 | 1,587,090 | 9,740,370 | 558,592 | 71,370,457 | 2,715,592 |
| Landed at Portland in 1919 | 7,215,579 | 113,363 | | 21,713,191 | 688,976 | 5,752 | 165 | 21,718,943 | 689,411 |

* Includes herring from Newfoundland, 3,697,024 pounds salted, value \$110,157.

The fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by fishing vessels each year are taken principally from fishing grounds lying off the coast of the United States. In the calendar year 1920, 78.88 per cent of the quantity and 79 per cent of the value of the catch landed by American and Canadian fishing vessels were taken from these grounds; 3.35 per cent of the quantity and 4.63 per cent of the value, consisting largely of herring, from fishing banks off the coast of Newfoundland, and 17.75 per cent of the quantity and 16.36 per cent of the value from fishing grounds off the Canadian Provinces. Newfoundland herring constituted 1.73 per cent of the quantity and 1.33 per cent of the value of the fishery products landed at these ports during the year. The herring were taken from the treaty coast of Newfoundland, and the cod, haddock, hake, halibut, and other species from that region were obtained from fishing banks on the high seas. All fish caught by American fishing vessels off the coast of the Canadian Provinces were from offshore fishing grounds. The catch from each of these regions is given in detail in the following table:

QUANTITY AND VALUE OF FISH LANDED BY AMERICAN AND CANADIAN FISHING VESSELS AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., IN 1920, FROM FISHING GROUNDS OFF THE COAST OF THE UNITED STATES, NEWFOUNDLAND, AND CANADIAN PROVINCES.

| Species. | United States. | | Newfoundland. | | Canadian Provinces. | | Total. | |
|---------------------------|----------------|-------------|---------------|----------|---------------------|-----------|-------------|-------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Cod: | | | | | | | | |
| Fresh..... | 38,032,530 | \$1,802,329 | 1,056,142 | \$32,010 | 19,318,495 | \$597,081 | 58,407,167 | \$2,431,420 |
| Salted..... | 135,900 | 7,020 | 510,480 | 29,529 | 3,212,035 | 169,668 | 3,858,415 | 206,217 |
| Haddock: | | | | | | | | |
| Fresh..... | 70,576,671 | 2,594,729 | 15,086 | 257 | 4,643,277 | 143,728 | 75,235,034 | 2,738,714 |
| Salted..... | | | 9,750 | 297 | 34,693 | 1,041 | 44,443 | 1,338 |
| Hake: | | | | | | | | |
| Fresh..... | 4,207,942 | 143,136 | 134,415 | 2,521 | 323,765 | 6,785 | 4,666,122 | 152,442 |
| Salted..... | 282 | 10 | 25,785 | 724 | 29,167 | 700 | 55,234 | 1,434 |
| Pollock: | | | | | | | | |
| Fresh..... | 8,065,206 | 245,375 | 29,135 | 5,615 | 444,525 | 10,495 | 8,538,866 | 261,485 |
| Salted..... | 2,885 | 86 | 2,005 | 60 | 17,145 | 497 | 22,035 | 643 |
| Cusk: | | | | | | | | |
| Fresh..... | 1,253,961 | 35,827 | 49,065 | 927 | 546,100 | 11,078 | 1,849,126 | 47,832 |
| Salted..... | 502 | 14 | 2,765 | 97 | 2,346 | 127 | 5,613 | 238 |
| Halibut: | | | | | | | | |
| Fresh..... | 1,619,978 | 328,071 | 1,048,314 | 198,164 | 1,099,302 | 213,201 | 3,767,594 | 739,436 |
| Salted..... | 7,000 | 700 | 4,476 | 566 | 10,260 | 1,119 | 21,736 | 2,385 |
| Mackerel: | | | | | | | | |
| Fresh..... | 5,045,201 | 550,596 | | | 1,239,328 | 120,714 | 6,284,529 | 671,310 |
| Salted..... | 345,305 | 34,927 | | | 663,887 | 56,857 | 1,009,192 | 91,784 |
| Herring: | | | | | | | | |
| Fresh..... | 3,900,960 | 56,144 | | | | | 3,900,960 | 56,144 |
| Salted..... | | | 3,097,024 | 110,157 | | | 3,097,024 | 110,157 |
| Swordfish: Fresh..... | 2,471,837 | 481,399 | 751 | 203 | 59,081 | 12,600 | 2,531,669 | 494,202 |
| Miscellaneous: Fresh..... | 4,973,397 | 219,458 | 70 | 2 | 12,475 | 372 | 4,985,942 | 219,832 |
| Total..... | 140,639,557 | 6,499,821 | 5,985,263 | 381,129 | 31,655,881 | 1,346,061 | 178,280,701 | 8,227,013 |

SPECIES.

COD.

In 1920 the fishing fleet landing fish at Boston, Gloucester, and Portland was not quite so large as in the previous year. There were 20 vessels in the salt-bank fishery, or 11 more than in the previous year, and 111 in the market fishery, the same number as in the previous year. These vessels landed their fares of cod and other

ground fish at these ports during the year, and large quantities of cod were also landed by vessels fishing on the shore grounds. The total catch of cod landed at these ports during the year was 62,265,582 pounds, valued at \$2,637,637, of which 58,407,167 pounds, valued at \$2,431,420, were fresh, and 3,858,415 pounds, valued at \$206,217, were salted. Cod ranked second among the various species landed.

HADDOCK.

The catch of haddock for the year ranked first in both quantity and value, exceeding that of cod by 13,013,895 pounds and \$102,415. The quantity of haddock landed at these ports by fishing vessels during the year amounted to 75,279,477 pounds, valued at \$2,740,052, all of which was fresh except 44,445 pounds, valued at \$1,338. These fish were taken chiefly on Georges Bank and in South Channel, and the greater part of the catch, or 64,751,888 pounds, valued at \$2,746,828, was landed at Boston.

HAKE.

The catch of hake amounted to 4,721,356 pounds, valued at \$153,876, all landed fresh except 55,234 pounds, valued at \$1,434, salted. There was an increase of 381,880 pounds, or 8.80 per cent, in the quantity, but a decrease of \$27,177, or 15.01 per cent, in the value as compared with the previous year. The yield of this species has been comparatively small in recent years.

POLLOCK.

The catch of pollock amounted to 8,560,901 pounds, valued at \$262,128, all landed fresh except 22,035 pounds, valued at \$643, salted. This was the smallest catch of pollock in many years. There was a falling off in the catch of this species of over 10,000,000 pounds as compared with the previous year.

CUSK.

The catch of cusk amounted to 1,854,739 pounds, valued at \$48,070, all of which was fresh, except 5,613 pounds, valued at \$238, salted. The yield was 200,000 pounds less than in the previous year. The catch of this species has declined considerably in recent years.

HALIBUT.

The quantity of halibut landed was 3,789,330 pounds, valued at \$741,821, all of which was fresh except 21,736 pounds salted, valued at \$2,385. There was an increase of 1,674,669 pounds in quantity and \$354,630 in value as compared with the previous year. The catch was the largest taken in any year in the past five years. The next largest catch in this period was in 1916, when 3,458,765 pounds were landed at these ports. There has been a large increase in the receipts of halibut at Portland, which amounted in 1920 to 1,159,973 pounds, the next largest in the past five years being 535,314 pounds in 1916. There has also been a large increase in the receipts of halibut at Boston in recent years, but a decrease in those at Gloucester.

MACKEREL.

The total catch of fresh mackerel taken by the American fishing fleet in 1920 was 79,799 barrels, compared with 53,992 barrels in 1919, an increase of 25,807 barrels. The total catch of salted mackerel was 4,897 barrels, compared with 7,007 barrels the previous year, a decrease of 2,110 barrels. The quantity of mackerel landed at Boston, Gloucester, and Portland by the fishing fleet during the year was 7,293,721 pounds, valued at \$763,094, of which 6,284,529 pounds, valued at \$671,310, were fresh, and 1,009,192 pounds, valued at \$91,784, were salted. These were all landed by American fishing vessels. There was an increase in the total catch of mackerel landed at these ports of 1,580,525 pounds in quantity and \$215,852 in value over the previous year.

The season of 1920 was one of the best on record in the southern mackerel fishery for both the purse-seine and gill-net vessels. The fleet numbered about 50 seiners and 125 netters. The first fare, consisting of 3,600 pounds of large mackerel, was landed by a Gloucester vessel, April 14, at Cape May. Some of the best stocks made by the seiners in the southern fishery were from \$9,153 to \$26,449, the crews sharing from \$197 to \$649. The mackerel caught weighed from $1\frac{1}{2}$ to $3\frac{1}{2}$ pounds each, averaging about 2 pounds each, and sold from 8 to 22 cents per pound, according to market conditions. The schooner *Helen G. McLean*, from Nova Scotia, engaged in the southern mackerel fishery, and is said to be the only Canadian vessel to engage in this fishery for 25 years. The first arrival at Boston was a fare of 35,000 pounds of large and medium fresh mackerel on May 14, caught 35 miles south by west of Block Island, and sold at 18 cents per pound. In May there was a large body of mackerel off South Shoal Lightship, and the receipts at Boston landed by vessels were larger than for the same month in any recent year. The catch of mackerel on the Cape Shore was disappointing; the weather was foggy and the fish were well offshore, wild, and hard to catch. The first fares landed at Boston from this locality arrived on June 7. The fresh mackerel sold at 12 cents per pound and the salted mackerel at \$17 to \$17.50 per barrel. Later arrivals of fresh mackerel sold from 10 to $10\frac{1}{2}$ cents per pound. The Cape Shore fleet consisted of 30 vessels, which landed 1,290,000 pounds of fresh mackerel and 3,217 barrels of salt mackerel, compared with 32 vessels, and 2,119,000 pounds of fresh and 6,275 barrels of salt mackerel the previous year. The total catch of mackerel up to July 1 was 60,842 barrels fresh and 3,357 barrels salted, compared with 38,787 barrels fresh and 6,452 barrels salted the previous year.

SWORDFISH.

The catch of swordfish amounted to 2,531,669 pounds, valued at \$494,202. The number of vessels engaged in this fishery was 62, or 6 more than in the previous year, and there was a large increase in the catch.

FLOUNDERS.

The catch of flounders in the vessel fisheries amounted to 3,637,774 pounds, valued at \$166,895, an increase of 1,185,918 pounds, or 48.36 per cent, in quantity, and \$63,845, or 61.95 per cent, in value.

The catch taken by boats under 5 tons net tonnage is not included in these statistics.

HERRING.

The catch of herring amounted to 6,997,984 pounds, valued at \$166,301. Of this quantity, 3,900,960 pounds, valued at \$56,144, were taken off the coast of the United States and landed fresh, and 3,097,024 pounds, valued at \$110,157, were salted Newfoundland herring.

VESSEL FISHERIES AT SEATTLE, WASH.

In the vessel fisheries at Seattle, Wash., there has been some increase in the total quantity and value of products landed by the fishing fleet, but considerable falling off in the products landed by collecting vessels as compared with the previous year. The increase in products landed by the fishing fleet was due to a larger catch of halibut, there being a marked decrease in the catch of sablefish, "lingcod," and rockfishes. Statistics of the vessel fisheries at Seattle have been collected by the local agent and published as monthly and annual statistical bulletins, giving the quantity and value of fishery products landed by American fishing and collecting vessels at that port.

In 1920 the fishing fleet at Seattle landed 822 trips, aggregating 14,355,450 pounds of fish, having a value to the fishermen of \$1,992,759. This catch was taken from the various fishing grounds along the coast from Oregon to Portlock Bank, Alaska. The fishing areas from which the largest quantities of fish were obtained were Flattery Banks, west coast of Vancouver Island, and Hecate Strait. The products included halibut, 12,683,450 pounds, valued at \$1,913,849; sablefish, 950,200 pounds, valued at \$49,963; "lingcod," 513,035 pounds, valued at \$21,153; and rockfishes, 208,765 pounds, valued at \$7,794. Compared with the previous year there was an increase of 152 trips by fishing vessels, and of 704,430 pounds, or 5.16 per cent, in the quantity, and of \$162,475, or 30.22 per cent, in the value, of the products landed. The catch of halibut increased 1,572,730 pounds, or 14.15 per cent, in quantity, and \$491,330, or 34.53 per cent, in value, but there was a decrease in the catch of other species landed by fishing vessels. Sablefish decreased 603,400 pounds, or 38.83 per cent, in quantity, and \$24,327, or 32.74 per cent, in value; "lingcod," 209,965 pounds, or 29.04 per cent, in quantity, and \$3,280, or 13.42 per cent, in value; and rockfishes, 54,935 pounds, or 20.83 per cent, in quantity, and \$1,248, or 13.80 per cent, in value.

The fishery products taken in Puget Sound and landed at Seattle by collecting vessels during the year amounted to 9,813,966 pounds, valued at \$881,066. These products included salmon, 7,911,820 pounds, valued at \$765,145; herring, 345,100 pounds, valued at \$5,714; sturgeon, 1,860 pounds, valued at \$186; steelhead trout, 139,882 pounds, valued at \$19,094; smelt, 521,201 pounds, valued at \$29,795; perch, 47,520 pounds, valued at \$3,002; rockfishes, 130,200 pounds, valued at \$8,793; "lingcod," 44,904 pounds, valued at \$2,324; flounders, 86,065 pounds, valued at \$1,720; sole, 128,920 pounds, valued at \$4,475; and crabs, 456,494 pounds, valued at \$40,818. There was a decrease in the products landed by collecting vessels, compared with the previous year, of 1,995,484 pounds, or 16.89 per cent, in quantity, and \$102,753, or 10.44 per cent, in value.

This was due to a large falling off in the catch of salmon, amounting to 2,475,883 pounds, or 23.83 per cent. in quantity, and \$137,572, or 15.23 per cent. in value. The decrease in salmon was offset to some extent by a considerable increase in various less important species.

The following table and figure 5 present the most productive fishing grounds in the order of their importance visited by the fishing fleet at Seattle during the past five years, with the quantity of halibut and other species taken from these areas in 1920, and also the average production of these species for the 5-year period from 1916 to 1920, inclusive:

POUNDS OF HALIBUT AND OTHER FISH LANDED BY FISHING VESSELS AT SEATTLE, WASH., IN 1920, COMPARED WITH THE 5-YEAR AVERAGE, 1916 TO 1920, SHOWN BY FISHING GROUNDS.

| Fishing grounds. | Halibut. | Other fish. | Total. |
|---------------------------------------|-----------|-------------|-----------|
| Hecate Strait: | | | |
| 1920..... | 4,645,300 | 208,300 | 4,853,600 |
| 5-year average..... | 3,285,343 | 335,321 | 3,620,664 |
| Flattery Banks: | | | |
| 1920..... | 2,661,000 | 806,500 | 3,467,500 |
| 5-year average..... | 2,504,936 | 1,376,590 | 3,881,526 |
| Vancouver Island (west coast): | | | |
| 1920..... | 1,873,600 | 387,800 | 2,261,400 |
| 5-year average..... | 1,051,370 | 497,800 | 1,549,170 |
| Portlock Bank: | | | |
| 1920..... | 952,050 | 1,600 | 953,650 |
| 5-year average..... | 1,444,804 | 61,091 | 1,505,895 |
| Yakutat grounds: | | | |
| 1920..... | 906,000 | 5,000 | 911,000 |
| 5-year average..... | 2,137,458 | 95,531 | 2,232,989 |
| All others: | | | |
| 1920..... | 1,645,500 | 262,800 | 1,908,300 |
| 5-year average..... | 2,237,298 | 785,166 | 3,022,464 |

FISHING GROUNDS

MILLIONS OF POUNDS

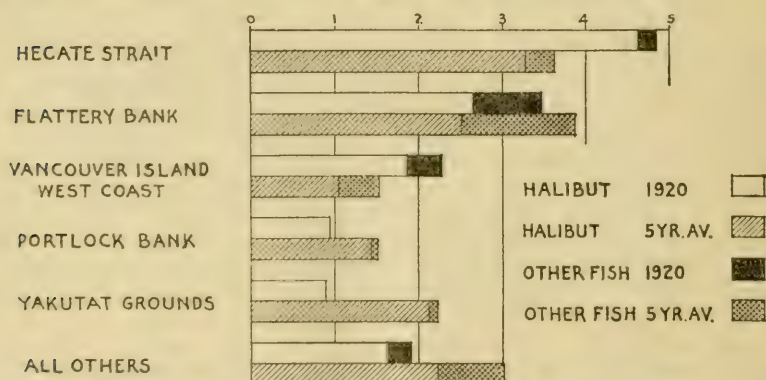


FIG. 5.—Quantities of halibut and other fish landed by fishing vessels at Seattle, Wash., in 1920, compared with the five-year average, 1916 to 1920, shown by fishing grounds.

The quantity and value of fishery products landed at Seattle by fishing and collecting vessels in 1920 are given in detail in the following table:

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS (FRESH) LANDED AT SEATTLE, WASH., BY AMERICAN FISHING VESSELS, CALENDAR YEAR 1920.

| | Number of trips. | Halibut. | | Sablefish. | |
|--------------------------------------|---------------------|----------------|---------------|----------------|---------------|
| BY FISHING GROUNDS. | | | | | |
| | | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Oregon coast | 2 | 49,000 | \$7,137 | | |
| Columbia River grounds..... | 1 | 30,000 | 3,940 | 3,000 | \$150 |
| Grays Harbor grounds..... | 13 | 218,000 | 32,892 | 153,000 | 7,650 |
| Flattery Banks..... | 326 | 2,661,000 | 421,536 | 421,100 | 22,440 |
| West coast, Vancouver Island..... | 166 | 1,873,600 | 318,092 | 210,900 | 11,888 |
| Cape Scott grounds..... | 18 | 198,000 | 27,966 | 4,000 | 200 |
| Queen Charlotte Islands grounds..... | 20 | 581,500 | 86,187 | 30,000 | 1,500 |
| Hecate Strait..... | 221 | 4,645,300 | 702,994 | 98,200 | 4,505 |
| Forrester Island grounds..... | 14 | 497,000 | 72,993 | 25,000 | 1,330 |
| Cape Spencer..... | 3 | 72,000 | 11,145 | | |
| Yakutat grounds..... | 24 | 906,000 | 114,943 | 5,000 | 300 |
| Portlock Bank..... | 14 | 952,030 | 114,024 | | |
| Total..... | 822 | 12,683,450 | 1,913,849 | 950,200 | 49,963 |
| BY MONTHS. | | | | | |
| January..... | 7 | 191,700 | 30,130 | 9,000 | 460 |
| February..... | 28 | 563,900 | 75,410 | 31,500 | 1,555 |
| March..... | 68 | 935,000 | 128,394 | 59,800 | 2,970 |
| April..... | 88 | 977,200 | 154,618 | 22,200 | 1,020 |
| May..... | 119 | 1,717,600 | 234,024 | 29,500 | 1,425 |
| June..... | 100 | 1,769,050 | 265,044 | 70,600 | 3,125 |
| July..... | 105 | 1,932,000 | 276,791 | 235,800 | 11,790 |
| August..... | 111 | 1,802,800 | 269,672 | 213,000 | 10,650 |
| September..... | 76 | 1,094,600 | 178,657 | 115,000 | 7,285 |
| October..... | 64 | 740,800 | 147,894 | 108,000 | 6,480 |
| November..... | 46 | 917,000 | 144,075 | 50,000 | 2,555 |
| December..... | 10 | 41,800 | 9,140 | 5,800 | 348 |
| Total..... | 822 | 12,683,450 | 1,913,849 | 950,200 | 49,963 |

| | "Lingcod." | | 'Rockfishes. | | Total. | |
|--------------------------------------|------------|--------|--------------|--------|------------|-----------|
| BY FISHING GROUNDS. | | | | | | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Oregon coast..... | | | | | 49,000 | \$7,137 |
| Columbia River grounds..... | 2,000 | \$60 | 1,000 | \$30 | 36,000 | 4,180 |
| Gray's Harbor grounds..... | 14,000 | 500 | 2,000 | 60 | 387,000 | 41,102 |
| Flattery Banks..... | 298,365 | 12,491 | 87,035 | 3,453 | 3,467,500 | 459,920 |
| West coast, Vancouver Island..... | 133,860 | 5,825 | 43,040 | 2,007 | 2,261,400 | 337,812 |
| Cape Scott grounds..... | 6,500 | 130 | 3,300 | 66 | 211,800 | 28,362 |
| Queen Charlotte Islands grounds..... | 8,000 | 300 | 6,000 | 180 | 625,500 | 88,167 |
| Hecate Strait..... | 45,710 | 1,676 | 64,390 | 1,878 | 4,853,600 | 711,053 |
| Forrester Island grounds..... | 3,000 | 140 | 2,000 | 120 | 527,000 | 74,583 |
| Cape Spencer..... | | | | | 72,000 | 11,145 |
| Yakutat grounds..... | | | | | 911,000 | 115,243 |
| Portlock Bank..... | 1,600 | 31 | | | 953,650 | 114,055 |
| Total..... | 513,035 | 21,153 | 208,765 | 7,794 | 14,355,450 | 1,992,759 |
| BY MONTH. | | | | | | |
| January..... | 8,000 | 539 | | | 208,700 | 31,120 |
| February..... | 25,000 | 1,149 | 8,000 | 580 | 628,400 | 78,685 |
| March..... | 48,000 | 1,597 | 20,800 | 644 | 1,661,500 | 133,515 |
| April..... | 93,535 | 2,498 | 35,065 | 1,204 | 1,139,600 | 159,250 |
| May..... | 29,000 | 580 | 15,800 | 276 | 1,789,900 | 236,305 |
| June..... | 25,600 | 591 | 19,000 | 350 | 1,882,250 | 269,120 |
| July..... | 29,000 | 590 | 16,000 | 360 | 2,209,800 | 289,501 |
| August..... | 57,000 | 2,289 | 15,500 | 595 | 2,088,300 | 283,117 |
| September..... | 144,000 | 8,497 | 49,000 | 2,655 | 1,102,600 | 197,094 |
| October..... | 48,500 | 2,730 | 16,000 | 940 | 913,300 | 158,044 |
| November..... | 9,500 | 410 | 4,000 | 180 | 980,500 | 147,520 |
| December..... | | | | | 47,600 | 9,488 |
| Total..... | 513,035 | 21,153 | 208,765 | 7,794 | 14,355,450 | 1,992,759 |

FISHERY PRODUCTS, BY MONTHS, TAKEN IN PUGET SOUND AND LANDED AT SEATTLE, WASH., BY COLLECTING VESSELS, 1920.

| Species. | January. | | February. | | March. | | April. | |
|-----------------------|----------|---------|-----------|---------|---------|--------|---------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Herring..... | 42,000 | \$2,440 | 144,000 | \$1,440 | 55,000 | \$550 | | |
| Salmon: | | | | | | | | |
| Chum or keta..... | 120,000 | 8,000 | | | | | | |
| King or spring..... | 14,000 | 1,400 | | | | | 47,200 | \$7,080 |
| Coho or silver..... | | | | | | | 60,000 | 9,000 |
| Miscellaneous..... | 4,000 | 400 | | | | | | |
| Trout: Steelhead..... | | | | | | | 21,600 | 3,190 |
| Smelt..... | 55,000 | 2,200 | 56,000 | 1,960 | 20,000 | 1,600 | 25,000 | 3,000 |
| Perch..... | | | | | 5,100 | 357 | 8,200 | 452 |
| Rockfishes..... | 8,400 | 504 | 16,600 | 1,162 | 15,650 | 782 | 11,000 | 770 |
| "Lingcod"..... | 6,000 | 300 | 12,000 | 720 | 8,000 | 400 | | |
| Flounders..... | | | | | 12,600 | 252 | 6,880 | 137 |
| Sole..... | 21,600 | 840 | 28,000 | 700 | 20,000 | 800 | 14,000 | 560 |
| Crabs..... | 56,078 | 4,678 | 48,000 | 3,491 | 70,620 | 4,865 | 19,260 | 1,400 |
| Total..... | 327,078 | 20,762 | 304,600 | 9,473 | 206,970 | 9,606 | 213,140 | 25,589 |

| Species. | May. | | June. | | July. | |
|-----------------------|---------|----------|-----------|---------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Sturgeon..... | | | 1,860 | \$186 | | |
| Herring..... | | | 12,300 | 246 | 3,300 | \$33 |
| Salmon: | | | | | | |
| Humpback or pink..... | | | | | 31,750 | 1,905 |
| Chum or keta..... | | | | | 55,750 | 2,787 |
| King or spring..... | 248,000 | \$34,720 | 803,450 | 112,483 | 860,930 | 103,311 |
| Coho or silver..... | | | 38,440 | 4,612 | 126,730 | 12,673 |
| Sockeye or red..... | | | 80,000 | 9,600 | 26,680 | 2,668 |
| Miscellaneous..... | 42,000 | 5,880 | | | | |
| Trout: Steelhead..... | 24,000 | 3,360 | 29,660 | 3,559 | 5,300 | 530 |
| Perch..... | | | 6,320 | 379 | 4,000 | 240 |
| Rockfishes..... | 10,000 | 800 | 13,800 | 897 | 8,000 | 560 |
| Flounders..... | 9,600 | 192 | 17,500 | 350 | 10,600 | 212 |
| Sole..... | 15,000 | 600 | 9,640 | 289 | | |
| Total..... | 348,600 | 45,552 | 1,012,970 | 132,601 | 1,133,040 | 124,919 |

| Species. | August. | | September. | | October. | |
|-----------------------|-----------|---------|------------|--------|-----------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Herring..... | 18,000 | \$300 | 10,000 | \$100 | | |
| Salmon: | | | | | | |
| Humpback or pink..... | 8,400 | 336 | | | | |
| Chum or keta..... | 158,540 | 6,340 | 250,800 | 12,740 | 1,438,280 | \$86,296 |
| King or spring..... | 895,800 | 107,496 | 320,150 | 35,216 | 59,540 | 7,144 |
| Coho or silver..... | 196,180 | 20,618 | 312,600 | 31,260 | 464,400 | 46,440 |
| Sockeye or red..... | 20,000 | 2,040 | | | | |
| Trout: Steelhead..... | | | | | 2,590 | 259 |
| Smelt..... | 80,600 | 4,030 | 28,999 | 1,680 | 76,660 | 4,597 |
| Perch..... | | | 5,300 | 318 | 4,600 | 276 |
| Rockfishes..... | 12,000 | 840 | 10,150 | 710 | 10,000 | 600 |
| Flounders..... | | | 12,000 | 240 | 7,225 | 144 |
| Sole..... | 6,680 | 266 | | | | |
| Crabs..... | | | | | 91,608 | 7,287 |
| Total..... | 1,396,200 | 142,266 | 949,999 | 82,264 | 2,154,903 | 153,043 |

| Species. | November. | | December. | | Total. | |
|-----------------------|-----------|----------|-----------|--------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Sturgeon..... | | | | | 1,860 | \$186 |
| Herring..... | | | 60,500 | \$605 | 345,100 | 5,714 |
| Salmon: | | | | | | |
| Humpback or pink..... | | | | | 40,150 | 2,241 |
| Chum or keta..... | 769,920 | \$33,496 | 359,000 | 43,080 | 3,152,290 | 197,739 |
| King or spring..... | 12,600 | 1,764 | 8,000 | 1,280 | 3,269,670 | 411,594 |
| Coho or silver..... | 49,080 | 3,926 | 29,600 | 4,154 | 1,277,030 | 132,683 |
| Sockeye or red..... | | | | | 126,680 | 14,308 |
| Miscellaneous..... | | | | | 46,000 | 6,280 |
| Trout: Steelhead..... | 10,452 | 1,254 | 46,280 | 6,942 | 139,882 | 19,094 |
| Smelt..... | 106,142 | 6,368 | 72,800 | 4,360 | 521,201 | 29,795 |
| Perch..... | 14,000 | 980 | | | 47,520 | 3,002 |
| Rockfishes..... | 8,600 | 688 | 6,000 | 480 | 130,200 | 8,793 |
| "Lingcod"..... | 12,424 | 645 | 6,480 | 259 | 44,904 | 2,324 |
| Flounders..... | 6,060 | 121 | 3,600 | 72 | 86,065 | 1,720 |
| Sole..... | | | 14,000 | 420 | 128,920 | 4,475 |
| Crabs..... | 79,200 | 11,880 | 91,728 | 7,217 | 1,456,494 | 40,818 |
| Total..... | 1,068,478 | 66,122 | 697,988 | 68,869 | 9,813,966 | 881,066 |

120,650 dozen.

FISHERY PRODUCTS RECEIVED AT MUNICIPAL FISH WHARF AND MARKET, WASHINGTON, D. C.⁶

The total receipts of fishery products at the Municipal Fish Wharf and Market, Washington, D. C., in 1920, were 8,573,984 pounds, a decrease of 2,159,102 pounds, or 20.11 per cent, as compared with 1919. The five most important products in terms of quantity were: Squeteagues or "sea trout," 1,925,334 pounds; oysters, 1,284,707 pounds, or 183,529 bushels; river herring, 1,068,660 pounds; shad, 1,035,822 pounds; and croaker, 743,415 pounds. These represent a total of 6,057,938 pounds, or 70.65 per cent of the entire receipts at this market for the year. Although differing in the order of their importance, these were the five principal species in 1919, representing 69.49 per cent of the entire receipts of the market for that year. The decrease in the total receipts of fish in 1920 as compared with the previous year is significant in view of the reported general decrease in the consumption of fishery products.

To supply local housewives with information as to species which are abundant in the Washington markets and seasons of abundance, the Bureau issued a post-card size fish calendar.

FISHERY PRODUCTS, IN POUNDS, RECEIVED AT MUNICIPAL FISH WHARF AND MARKET, WASHINGTON, D. C., 1920.

| Species. | January. | February. | March. | April. | May. | June. | July. |
|---------------------------------|----------|-----------|---------|---------|---------|---------|---------|
| Bass, black and sea..... | 25,657 | 14,181 | 34,904 | 2,200 | 2,400 | 3,495 | 7,228 |
| Bluefish..... | 35 | | | | 800 | 10,950 | 5,550 |
| Butterfish..... | 500 | | | 1,300 | 15,700 | 40,300 | 59,850 |
| Carp..... | 1,270 | 13,471 | 14,534 | 10,205 | 17,969 | 9,654 | 1,954 |
| Catfish..... | 1,499 | 8,989 | 47,676 | 26,727 | 16,083 | 24,022 | 8,806 |
| Cod..... | 4,400 | 6,400 | 5,700 | 2,900 | 7,100 | 9,050 | 1,900 |
| Croaker..... | 480 | 800 | 101,100 | 218,919 | 89,397 | 120,712 | 96,263 |
| Eels..... | | | 355 | 2,155 | | 673 | 338 |
| Flounders..... | 4,802 | 11,105 | 15,872 | 11,807 | 14,514 | 10,040 | 2,700 |
| Gizzard shad..... | 29,963 | 2,864 | 1,000 | | | | |
| Hardlock..... | 6,867 | 43,450 | 26,200 | 3,420 | 2,750 | 3,100 | 1,300 |
| Hake..... | 2,500 | | | | | | |
| Halibut..... | 28,427 | 10,700 | 3,950 | 200 | 2,700 | 6,596 | 4,960 |
| Herring: | | | | | | | |
| River..... | 72,400 | 80,200 | 276,250 | 509,671 | 99,221 | 112 | |
| Sea..... | 30,000 | | | | | | |
| Hickory shad or "jacks"..... | 706 | 4,395 | 9,349 | 7,347 | 45 | | |
| Kingfish..... | 200 | | | 400 | | | |
| Mackerel..... | 50,000 | 1,400 | 2,012 | 8,400 | 17,200 | 37,635 | 2,470 |
| Mullet..... | 1,519 | 312 | 593 | | 150 | | |
| Perch..... | 2,400 | 11,002 | 71,167 | 25,459 | 10,563 | 1,994 | 3,976 |
| Pigfish..... | 200 | | | | | | |
| Pike or pickerel..... | 1,875 | 3,864 | 3,362 | 250 | 100 | 15 | 88 |
| Pollock..... | 2,700 | 1,500 | 4,100 | 2,000 | 600 | 1,000 | 900 |
| Redfish or red drum..... | | 200 | 400 | 400 | | | |
| Salmon..... | 6,558 | | 850 | | | 200 | 1,200 |
| Scup or porgy..... | | | | | | 1,000 | 1,500 |
| Shad..... | 1,400 | 21,842 | 184,625 | 685,298 | 118,602 | 1,100 | |
| Sheep head..... | 400 | | 300 | | | | |
| Smelt..... | 3,175 | 1,905 | 300 | | | | |
| Snappers..... | | | | | | | 6 |
| Spot..... | 300 | | 2,500 | 2,400 | 8,465 | 7,534 | 18,550 |
| Squeteagues or "sea trout"..... | 27,785 | 8,000 | 15,360 | 44,687 | 443,997 | 190,800 | 210,207 |
| Striped bass..... | 4,100 | 3,349 | 12,712 | 28,478 | 113,505 | 19,249 | 12,811 |
| Sturgeon..... | | | | 1,600 | 1,331 | | |
| Tilfish..... | | | | 400 | 1,450 | 400 | |
| Tullibee..... | | 1,000 | 2,000 | | | | |
| Whitefish..... | | | | 100 | | | |
| Whiting..... | 48,550 | 23,000 | 50,780 | | | | |
| Clams, hard..... | 5,632 | 8,768 | 6,656 | 6,376 | 14,520 | 9,888 | 17,387 |

¹ Includes 100 pounds white bass.

² Daily reports of the quantity of fishery products received at this market are received by the Bureau for tabulation through the courtesy of the Health Department of the District of Columbia.

FISHERY PRODUCTS, IN POUNDS, RECEIVED AT MUNICIPAL FISH WHARF AND MARKET,
WASHINGTON, D. C., 1920—Continued.

| Species. | January. | February. | March. | April. | May. | June. | July. |
|--------------------|----------|-----------|-----------|-----------|---------|---------|---------|
| Oysters: | | | | | | | |
| In the shell..... | 74,018 | 56,021 | 98,819 | 32,508 | 3,871 | 518 | 194 |
| Opened..... | 137,259 | 91,550 | 77,958 | 28,342 | 3,218 | | |
| Scallops..... | 80 | 160 | 240 | 400 | | | |
| Crabs..... | | | | 126 | 3,304 | 5,930 | 15,690 |
| Crabs, oyster..... | 100 | | | | | | |
| Crabmeat..... | 2,455 | 2,240 | 2,620 | 1,530 | 4,093 | 2,960 | 6,650 |
| Frogs..... | | | | 21 | 43 | 231 | |
| Lobster..... | 2,000 | | | | | | |
| Shrimp..... | 1,945 | 1,190 | 400 | 24,000 | | 250 | |
| Turtles..... | 1,245 | 990 | | 6 | 177 | 285 | 215 |
| Total..... | 588,522 | 435,748 | 1,074,849 | 1,720,092 | 914,806 | 531,693 | 480,723 |

| Species. | August. | September. | October. | November. | December. | Total. |
|---------------------------------|---------|------------|----------|-----------|-----------|-----------|
| Bass, black and sea..... | 2,293 | 280 | 1,386 | 16,044 | 32,001 | 142,069 |
| Bluefish..... | 10,975 | 11,695 | 13,875 | 600 | 1,500 | 50,980 |
| Butterfish..... | 63,600 | 66,850 | 27,100 | 22,400 | | 297,600 |
| Carp..... | 5,694 | 8,585 | 8,633 | 5,235 | | 17,167 |
| Catfish..... | 8,402 | 10,296 | 15,082 | 14,053 | 10,501 | 192,136 |
| Cod..... | 2,400 | 4,100 | 1,400 | 4,800 | 10,380 | 60,530 |
| Croaker..... | 69,066 | 5,537 | 19,459 | 16,152 | 5,530 | 743,415 |
| Eels..... | 79 | 458 | 2,111 | 1,378 | 509 | 9,054 |
| Flounders..... | 3,175 | 7,351 | 13,004 | 15,686 | 7,334 | 117,390 |
| Gizzard shad..... | | | | | 6,600 | 40,427 |
| Haddock..... | 2,600 | 7,800 | 14,625 | 5,400 | 212,650 | 120,162 |
| Hake..... | | | | 13,500 | 6,950 | 22,950 |
| Halibut..... | 3,325 | 5,516 | 2,400 | 2,942 | 4,250 | 75,966 |
| Herring: | | | | | | |
| River..... | | | | | 800 | 1,068,660 |
| Sea..... | | | | | | 30,000 |
| Hickory shad or "jacks"..... | | | | | | 21,872 |
| Kingfish..... | | | | | | 600 |
| Mackerel..... | 5,600 | 11,500 | 2,200 | 10,300 | 13,450 | 162,167 |
| Mullet..... | 81 | 119 | 678 | 1,875 | 3,084 | 8,411 |
| Perch..... | 5,764 | 2,878 | 4,886 | 12,571 | 9,390 | 165,540 |
| Pigfish..... | | | | | | 200 |
| Pike or pickerel..... | 280 | 850 | 2,144 | 2,754 | 5,094 | 20,676 |
| Pollock..... | 2,400 | 2,300 | 1,400 | 2,700 | 10,150 | 32,050 |
| Pompano..... | | 1,000 | | | | 1,000 |
| Redfish or red drum..... | | 675 | 40 | 3,100 | | 4,815 |
| Salmon..... | 715 | 5,525 | 10,580 | 300 | | 25,928 |
| Scup or porgy..... | | | | | | 2,500 |
| Shad..... | | 200 | 785 | 1,750 | 20,250 | 1,035,822 |
| Sheepshead..... | | | | | | 800 |
| Smelt..... | | | | | 1,450 | 6,830 |
| Snappers..... | | 27 | | | 85 | 118 |
| Spot..... | 19,863 | 36,395 | 32,480 | 7,200 | 1,800 | 137,487 |
| Squeteagues or "sea trout"..... | 199,518 | 304,186 | 307,564 | 115,600 | 48,530 | 1,925,334 |
| Striped bass..... | 17,192 | 25,360 | 37,413 | 48,230 | 5,704 | 228,123 |
| Sturgeon..... | 53 | | 107 | 200 | | 3,291 |
| Tilefish..... | | 900 | 5,300 | 1,700 | 900 | 11,050 |
| Tullibee..... | | | | | | 3,000 |
| Whitefish..... | | | 100 | | | 200 |
| Whiting..... | | | | 44,300 | 400 | 167,030 |
| Clams, hard..... | 8,864 | 5,871 | 4,526 | 1,760 | 1,344 | 91,592 |
| Oysters: | | | | | | |
| In the shell..... | 323 | 3,588 | 103,898 | 164,374 | 147,539 | 3685,671 |
| Opened..... | 413 | 30,116 | 52,431 | 82,436 | 95,313 | 599,036 |
| Scallops..... | | | | | | 880 |
| Crabs..... | 15,550 | 24,213 | 6,525 | 375 | | 71,913 |
| Crabs, oyster..... | | | | | | 100 |
| Crabmeat..... | 7,290 | 2,700 | 135 | | 45 | 32,718 |
| Frogs..... | | | | | | 295 |
| Lobster..... | | | | | | 2,000 |
| Shrimp..... | 50 | 400 | 815 | 437 | 298 | 29,785 |
| Turtles..... | 300 | 100 | 93 | | | 3,411 |
| Total..... | 455,865 | 587,361 | 683,175 | 620,152 | 480,998 | 8,573,984 |

¹ Includes 250 pounds smoked haddock.² Includes 600 pounds smoked haddock.³ 97,953 bushels. The oysters have been reduced to pounds on the basis of 7 pounds of meat to a bushel and 84 pounds to a gallon⁴ 72,610 gallons.

SHAD FISHERY OF THE HUDSON RIVER.⁷

In 1920 there were 368 persons engaged in this fishery, an increase of 69 persons as compared with 1919. The investment amounted to \$40,351, which includes 185 rowboats, valued at \$10,011; 10 gasoline boats, valued at \$2,050; 200 gill nets, valued at \$23,710; 10 seines, valued at \$1,655; and shore and accessory property to the value of \$2,925.

The catch numbered 49,315 fish, or 199,844 pounds, valued at \$56,309. Of this quantity the number of shad taken on the New York side of the river was 39,692, or 157,715 pounds, valued at \$43,882, and on the New Jersey side, 9,623 shad, or 42,129 pounds, valued at \$12,427. The catch with gill nets was 47,444 shad, or 96.2 per cent of the total catch. The average number of shad taken per gill net was 237.

Compared with 1919 there was a decrease in the number of shad taken of 40,986, or 45.38 per cent, and of \$27,415, or 32.74 per cent, in the value. Compared with 1918 there was a decrease of 18,088, or 26.83 per cent, in the number of fish and an increase of \$1,131, or 2.34 per cent, in the value.

SHAD FISHERY OF THE HUDSON RIVER, 1920.

| Item. | New York. | | | New Jersey. | | | Total. | | |
|-----------------------------------|-----------|---------|---------|-------------|---------|--------|---------|---------|----------|
| | Number. | Pounds. | Value. | Number. | Pounds. | Value. | Number. | Pounds. | Value. |
| Fishermen..... | 352 | | | 16 | | | 368 | | |
| Rowboats..... | 178 | | \$9,486 | 7 | | \$325 | 185 | | \$10,011 |
| Gasoline boats..... | 7 | | 1,100 | 3 | | 950 | 10 | | 2,050 |
| Gill nets..... | 190 | | 21,810 | 10 | | 1,900 | 200 | | 23,710 |
| Seines..... | 10 | | 1,655 | | | | 10 | | 1,655 |
| Shore and accessory property..... | | | 1,925 | | | 1,000 | | | 2,925 |
| Total..... | | | 35,976 | | | 4,375 | | | 40,351 |
| Shad caught: | | | | | | | | | |
| With gill nets..... | 37,821 | 150,658 | 42,089 | 9,623 | 42,129 | 12,427 | 47,444 | 192,787 | 54,516 |
| With seines..... | 1,871 | 7,057 | 1,793 | | | | 1,871 | 7,057 | 1,793 |
| Total..... | 39,692 | 157,715 | 43,882 | 9,623 | 42,129 | 12,427 | 49,315 | 199,844 | 56,309 |

SHAD AND ALEWIFE FISHERY OF THE POTOMAC RIVER.⁸

In 1920 there were 753 persons engaged in this fishery, using 451 boats, valued at \$83,889; 271 pound nets, valued at \$126,455; 211 gill nets and 1 haul seine, valued at \$39,620; and shore and accessory property to the value of \$1,375.

The catch of shad was slightly smaller than in 1919, numbering 529,358, or 1,979,780 pounds, valued at \$334,464. Of this quantity 80,944 shad, or 302,237 pounds, valued at \$55,963, were taken by Maryland fishermen and 448,414 shad, or 1,677,543 pounds, valued at \$278,501, by Virginia fishermen. The catch of river herring by Maryland fishermen numbered 1,077,775, or 538,888 pounds, valued at \$13,940, and by Virginia fishermen 7,681,561, or 3,813,780 pounds, valued at \$41,197, the total catch being 8,759,336, or 4,352,668 pounds, valued at \$55,137. This represents a decrease of 108,566 in number and \$5,879 in the value as compared with 1919.

⁷ The canvass of this fishery was made by Rob Leon Greer, Statistical Agent, U. S. Bureau of Fisheries.

⁸ The canvass of this fishery was made by G. W. Hoofnagle, apprentice fish-culturist, Edenton, N. C.

SHAD AND ALEWIFE FISHERY OF THE POTOMAC RIVER, 1920.

| Item. | Maryland. | | | Virginia. | | | Total. | | |
|--|-----------|---------|---------|-----------|-----------|---------|-----------|-----------|---------|
| | Number. | Pounds. | Value. | Number. | Pounds. | Value. | Number. | Pounds. | Value. |
| Fishermen..... | 204 | | | 549 | | | 753 | | |
| Row boats..... | 87 | | \$3,225 | 118 | | \$4,047 | 205 | | \$7,272 |
| Gasoline..... | 28 | | 6,620 | 218 | | 69,997 | 246 | | 76,617 |
| Pound nets..... | 71 | | 10,360 | 200 | | 116,095 | 271 | | 126,455 |
| Gill nets and seines ¹ | 66 | | 13,800 | 146 | | 25,820 | 212 | | 39,620 |
| Shore and accessory property..... | | | 300 | | | 1,075 | | | 1,375 |
| Total..... | | | 34,305 | | | 217,034 | | | 251,339 |
| Shad caught: | | | | | | | | | |
| With pound nets and traps..... | 7,144 | 26,487 | 4,263 | 356,552 | 1,326,923 | 211,039 | 363,696 | 1,353,410 | 215,302 |
| With gill nets and seines ¹ | 73,800 | 275,750 | 51,700 | 91,862 | 350,620 | 67,462 | 165,662 | 626,370 | 119,162 |
| Total..... | 80,944 | 302,237 | 55,963 | 448,414 | 1,677,543 | 278,501 | 529,358 | 1,979,780 | 334,464 |
| Alewives caught: | | | | | | | | | |
| With pound nets and traps..... | 757,775 | 378,888 | 7,540 | 7,477,561 | 3,711,780 | 37,117 | 8,235,336 | 4,090,668 | 44,657 |
| With gill nets and seines ¹ | 320,000 | 160,000 | 6,400 | 204,000 | 102,000 | 4,080 | 524,000 | 262,000 | 10,480 |
| Total..... | 1,077,775 | 538,888 | 13,940 | 7,681,561 | 3,813,780 | 41,197 | 8,759,336 | 4,352,668 | 55,137 |

¹ Includes 1 haul seine, with the catch, operated in Maryland.

FISH, FROZEN.

COLD-STORAGE HOLDINGS DURING 1920.

Beginning with October 15, 1917, the Bureau of Markets of the Department of Agriculture has issued monthly mimeographed reports of the storage holdings of frozen and cured fish and also a bulletin (No. 792) for holdings in 1918, in which the storage holdings are presented in diagrammatic form with discussions and tables. Brief summaries of holdings of frozen fish have appeared in The Market Reporter, published weekly by the same bureau. During 1920 the monthly mimeographed memoranda have contained the storage holdings on the fifteenth of the month by species, comparisons of holdings with other months, quantities frozen and quantities delivered since the fifteenth of previous month, comparisons with holdings at fifteenth of previous month, and storage holdings by geographic sections.

Appended is a summary of the holdings by species and by months for 1920, including totals for 1918 and 1919, which have been compiled from the reports of the Bureau of Markets:

COLD-STORAGE HOLDINGS OF FROZEN FISH, BY SPECIES FOR 1920, AND BY TOTALS FOR 1919 AND 1918,¹ GIVEN IN POUNDS.

| Species. | Jan. 15. | Feb. 15. | Mar. 15. | Apr. 15. | May 15. | June 15. |
|--------------------------------------|------------|------------|------------|------------|------------|------------|
| Bluefish..... | 301,383 | 232,912 | 135,206 | 91,190 | 108,967 | 219,124 |
| Butterfish..... | 459,374 | 334,741 | 253,706 | 206,915 | 181,621 | 200,877 |
| Ciscoes..... | 4,302,645 | 3,284,821 | 1,868,349 | 1,173,570 | 802,401 | 566,535 |
| Cod, hake, pollock, and haddock..... | 3,923,930 | 2,904,850 | 1,724,705 | 1,480,923 | 1,405,403 | 1,856,260 |
| Croaker..... | 82,314 | 37,952 | 10,528 | 31,111 | 33,944 | 61,023 |
| Halibut..... | 7,788,546 | 5,375,287 | 3,991,261 | 3,091,887 | 4,155,392 | 5,726,088 |
| Herring..... | 9,303,418 | 6,507,234 | 3,732,770 | 2,010,888 | 2,205,187 | 3,305,773 |
| Lake trout..... | 1,229,908 | 821,392 | 315,009 | 91,298 | 251,947 | 441,690 |
| Mackerel..... | 2,399,005 | 2,102,720 | 1,209,358 | 735,773 | 1,056,182 | 1,758,346 |
| Rockfishes..... | 400,880 | 200,888 | 234,771 | 178,661 | 139,704 | 162,537 |
| Sablefish..... | 1,374,336 | 765,428 | 508,469 | 306,910 | 253,414 | 177,546 |
| Salmon..... | 5,701,129 | 4,516,290 | 2,921,559 | 1,996,938 | 1,739,342 | 1,874,337 |
| Sea bass..... | 109,354 | 81,105 | 50,417 | 40,402 | 50,480 | 69,959 |
| Shad..... | 541,315 | 309,024 | 133,079 | 147,239 | 177,391 | 419,393 |
| Shad roe..... | 14,252 | 12,374 | 5,846 | 18,446 | 16,094 | 46,326 |
| Smelt, eulachon, etc..... | 610,700 | 689,722 | 387,922 | 202,832 | 142,963 | 110,246 |
| Squeteague..... | 439,011 | 291,179 | 95,709 | 57,188 | 38,462 | 123,598 |
| Squid..... | 422,208 | 282,791 | 183,922 | 95,895 | 93,745 | 517,814 |
| Whitefish..... | 2,220,140 | 1,964,965 | 1,371,491 | 822,721 | 381,594 | 287,471 |
| Whiting..... | 9,319,624 | 6,804,067 | 3,470,098 | 2,287,080 | 1,332,930 | 2,374,659 |
| Miscellaneous..... | 10,635,659 | 10,292,863 | 6,775,413 | 5,501,932 | 5,717,307 | 7,428,240 |
| Total, 1920..... | 61,499,121 | 47,962,625 | 29,379,675 | 20,569,824 | 20,284,470 | 27,730,842 |
| Total, 1919..... | 80,844,524 | 66,675,012 | 49,889,032 | 37,110,856 | 37,068,407 | 47,370,741 |
| Total, 1918..... | 49,562,848 | 35,907,071 | 28,457,301 | 26,548,472 | 31,403,425 | 50,298,027 |

| Species. | July 15. | Aug. 15. | Sept. 15. | Oct. 15. | Nov. 15. | Dec. 15. |
|--------------------------------------|------------|------------|------------|------------|------------|------------|
| Bluefish..... | 153,286 | 240,881 | 283,771 | 303,195 | 402,451 | 411,000 |
| Butterfish..... | 283,174 | 507,992 | 515,035 | 933,513 | 1,353,337 | 1,199,000 |
| Ciscoes..... | 629,704 | 2,152,233 | 4,865,638 | 6,306,065 | 6,045,395 | 6,533,000 |
| Cod, hake, pollock, and haddock..... | 1,690,735 | 2,113,959 | 2,577,704 | 3,040,676 | 3,785,894 | 3,538,000 |
| Croaker..... | 108,777 | 281,420 | 108,882 | 709,404 | 703,814 | 577,000 |
| Halibut..... | 6,600,561 | 8,620,889 | 10,340,381 | 10,661,832 | 9,761,076 | 8,694,000 |
| Herring..... | 5,342,182 | 5,480,143 | 5,430,419 | 6,083,108 | 6,582,737 | 7,738,000 |
| Lake trout..... | 463,095 | 354,365 | 354,599 | 963,694 | 1,075,026 | 2,108,000 |
| Mackerel..... | 3,064,809 | 3,014,641 | 2,677,822 | 2,620,092 | 2,788,666 | 2,405,000 |
| Rockfishes..... | 134,330 | 185,228 | 199,928 | 200,548 | 215,944 | 145,000 |
| Sablefish..... | 283,533 | 306,683 | 834,172 | 1,118,963 | 1,019,398 | 919,000 |
| Salmon..... | 2,563,384 | 3,467,706 | 4,676,452 | 6,771,546 | 8,094,984 | 7,128,000 |
| Sea bass..... | 85,493 | 121,771 | 109,134 | 106,504 | 123,598 | 130,000 |
| Shad..... | 433,773 | 473,731 | 502,435 | 493,734 | 475,704 | 340,000 |
| Shad roe..... | 62,328 | 49,416 | 42,973 | 41,984 | 41,772 | 42,000 |
| Smelt, eulachon, etc..... | 88,826 | 100,968 | 115,625 | 162,557 | 162,197 | 182,000 |
| Squeteague..... | 460,703 | 449,304 | 498,421 | 861,561 | 1,007,848 | 812,000 |
| Squid..... | 609,532 | 895,924 | 2,102,909 | 2,580,377 | 2,625,801 | 2,226,000 |
| Whitefish..... | 381,269 | 623,567 | 1,015,279 | 1,100,929 | 1,080,815 | 1,985,000 |
| Whiting..... | 4,395,009 | 4,630,018 | 5,618,393 | 9,536,391 | 9,412,377 | 7,811,000 |
| Miscellaneous..... | 7,928,975 | 8,563,480 | 8,439,277 | 9,854,135 | 10,459,900 | 10,466,000 |
| Total, 1920..... | 35,793,280 | 47,073,345 | 55,602,350 | 64,437,715 | 67,827,934 | 65,387,000 |
| Total, 1919..... | 59,365,929 | 64,740,173 | 63,554,569 | 76,138,809 | 78,477,304 | 73,935,025 |
| Total, 1918..... | 64,859,532 | 82,773,229 | 89,557,970 | 94,411,748 | 99,631,789 | 96,600,247 |

¹ The 1918 totals are taken from "Reports of Storage Holdings of Certain Food Products during 1918," by John O. Bell, U. S. Department of Agriculture Bulletin No. 782, and the 1919 and 1920 holdings from the mimeographed memoranda issued monthly by the Bureau of Markets.

QUANTITIES FROZEN IN 1920.

The quantities of fish frozen between January 15, 1920, and January 15, 1921, based on the monthly memoranda issued by the Bureau of Markets was 85,324,366 pounds. The principal varieties frozen were as follows: Halibut, 10,625,029 pounds; herring, 10,356,305 pounds; whiting, 10,208,755 pounds; salmon, 7,836,620 pounds; ciscoes, 6,968,750 pounds; mackerel, 4,835,173 pounds; cod, haddock, hake, and pollock, 3,940,163 pounds; and squid, 3,252,720 pounds. The item of miscellaneous fishes amounted to

16,454,317 pounds and includes albacore, bonito, burbot, catfish, eels, flounders, German and buffalo carp, horse mackerel, Spanish mackerel, perch, pike, pickerel, pompano, red snapper, sheephead, swordfish, tilefish, tuna, all kinds of fresh and salt water bass except sea bass, and all other frozen fish including soft crabs and bay scallops. The item of frozen shad of 411,398 pounds includes 31,063 pounds of shad roe. Figure 6 shows the relative amounts of each species frozen.

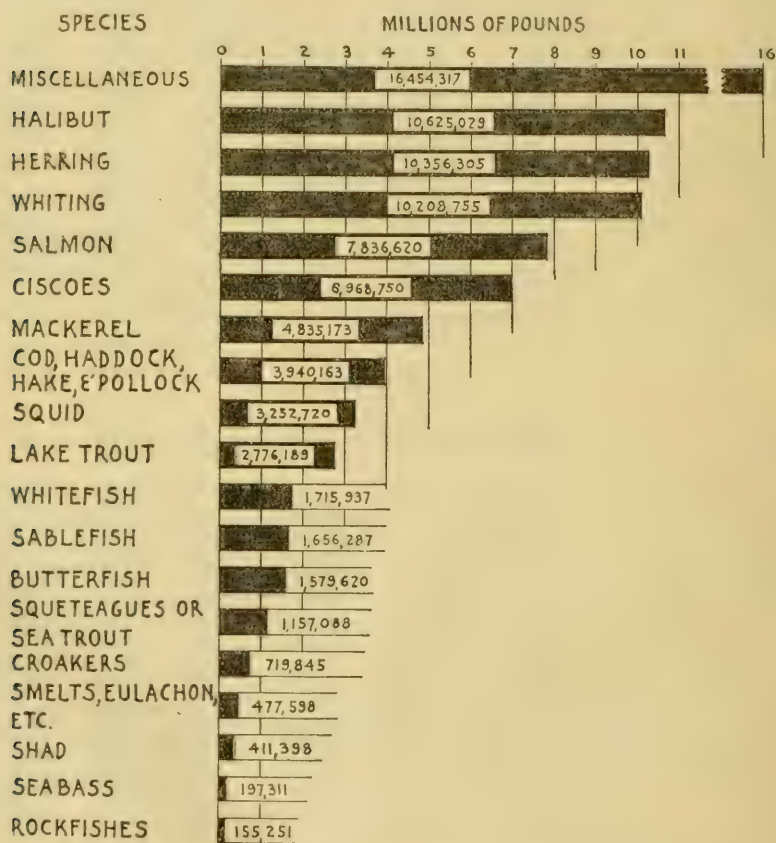


FIG. 6.—Quantities of fish frozen during 1920, shown by species.

FISHERIES OF CALIFORNIA IN 1920.

Through the courtesy of the California State Fish and Game Commission the Bureau has received copies of its monthly sheets showing the catch of fish by species and by localities for the calendar year 1920. In the appended table, page 57, these figures have been compiled by months and by species, such an arrangement being of value in ascertaining seasonal variation in catch. There has also been added a table, page 59, of the imports of fresh fish from Mexico to California centers during 1920.

COMMON AND SCIENTIFIC NAMES OF FISHES.

To provide a clearer understanding of the species to which reference is made in the tables and discussions, the following list of common and scientific names of the fishes of California, as accurately as it has been possible to ascertain them, is appended. As the reports do not in all cases distinguish between albacore and the species of tuna it is impracticable to separate the catch by species. Under flounders have been grouped the "bastard halibut" (*Paralichthys californicus*), the "turbot" (*Hypsopsetta guttulata*), sand dabs (*Citharichthys sordidus*), and a number of flounders locally designated as soles. The "hake" (*Merluccius productus*) of the west coast is closely related to the New England whiting, being a member of the same genus, and the adoption of the latter name would avoid confusion. *Menticirrhus undulatus* is designated as surfish, kingfish, and California whiting by the fishermen, and *Genyonemus lineatus*, another species belonging to the family of croakers, is commonly called kingfish. On the Atlantic seaboard the Bureau has recommended the adoption of the name king whiting for species of *Menticirrhus*. The "lingcod" is called cultus-cod on the California coast. Included with the catch of rockfishes are bocaccio (*Sebastes paucispinis*) and chilipepper (*S. goodei* and *jordani*). The young of the white sea bass (*Cynoscion nobilis*) are designated as "sea trout" and the species of sharks as grayfish by the fishermen.

| | |
|--|--|
| Albacore and tuna..... | { <i>Germo alalunga</i> . <i>Germo macropterus</i> . <i>Thunnus thynnus</i> . |
| Anchovies..... | { <i>Engraulis</i> (species). <i>Anchoiella</i> (species). |
| Barracuda..... | <i>Sphyrna argentea</i> . |
| Bluefish, California, or squeteague..... | <i>Cynoscion parvipinnis</i> . |
| Bonito or skipjack..... | <i>Sarda chilensis</i> . |
| Carp..... | <i>Cyprinus carpio</i> . |
| Catfish..... | <i>Ameiurus</i> (species). |
| Eels..... | { <i>Lycodontis mordax</i> . <i>Muraena</i> (species). |
| Flounders..... | <i>Pleuronectidae</i> (species). |
| Greenfish or rudderfish..... | <i>Girella nigricans</i> . |
| "Hake"..... | <i>Merluccius productus</i> . |
| Hardhead..... | <i>Orthodon microlepidotus</i> . |
| Herring..... | <i>Clupea pallasii</i> . |
| Kingfish..... | <i>Genyonemus lineatus</i> . |
| "Lingcod"..... | <i>Ophiodon elongatus</i> . |
| Mackerel..... | <i>Scomber japonicus</i> . |
| Mullet..... | <i>Mugil cephalus</i> . |
| "Perches," surf..... | <i>Embiotocidae</i> (species). |
| Pike, Sacramento..... | <i>Ptychocheilus oregonensis</i> . |
| Pilchard..... | <i>Sardinia cerulea</i> . |
| Pompano, California..... | <i>Palometa simillima</i> . |
| Rockfishes..... | { <i>Sebastes</i> (species). <i>Sebastichthys</i> (species). |
| Sablefish..... | <i>Anoplopoma fimbria</i> . |
| Salmon..... | <i>Oncorhynchus</i> (species). |
| Sculpin..... | <i>Scorpena guttata</i> . |
| Sea bass, black..... | <i>Stercolepis gigas</i> . |
| Sea basses or "rock bass"..... | { <i>Paralabrax clathratus</i> . <i>Paralabrax maculatofasciatus</i> . <i>Paralabrax nebulifer</i> . |
| Sea bass, white or squeteague..... | <i>Cynoscion nobilis</i> . |
| Shad..... | <i>Alosa sapidissima</i> . |
| Sharks..... | All <i>Selachii</i> except <i>Batoidei</i> . |

| | |
|------------------------------------|--------------------------------------|
| Sheepshead..... | <i>Anisotremus davidsonii</i> . |
| | <i>Caulolatilus princeps</i> . |
| | <i>Pimelometopon pulcher</i> . |
| Skates..... | <i>Raja</i> (species). |
| | <i>Platyrrhinoides triseriatus</i> . |
| "Smelt"..... | <i>Rhinobatus productus</i> . |
| Splittail..... | Atherinidae (species). |
| Steelhead trout..... | <i>Pogonichthys macrolepidotus</i> . |
| Striped bass..... | <i>Salmo gairdneri</i> . |
| | <i>Roccus lineatus</i> . |
| | <i>Dasyatis dipterura</i> . |
| Stingarees or stingrays..... | <i>Pteroplatea marmorata</i> . |
| | <i>Urolophus halleri</i> . |
| | <i>Myliobatis californicus</i> . |
| Suckers..... | <i>Catostomus occidentalis</i> . |
| Surflish..... | <i>Menticirrhus undulatus</i> . |
| Swordfish..... | <i>Xiphias gladius</i> . |
| Tomcod..... | <i>Microgadus proximus</i> . |
| Whitebait..... | Small fry of any fish. |
| Whitefish..... | <i>Caulolatilus princeps</i> . |
| Yellowtail..... | <i>Seriola dorsalis</i> . |
| Crabs..... | <i>Cancer magister</i> . |
| Shrimps..... | <i>Crango franciscorum</i> . |
| | <i>Crango nigricauda</i> . |
| | <i>Crango nigrimaculata</i> . |
| Sea crawfish or spiny lobster..... | <i>Panulirus interruptus</i> . |
| Abalones..... | <i>Haliotis</i> (species). |
| Clams: | |
| Hard..... | <i>Tivela stultorum</i> . |
| Soft..... | <i>Mya arenaria</i> . |
| Cockles..... | <i>Cardium</i> (species). |
| Limpets..... | Gastropoda (species). |
| Mussels..... | <i>Mytilus californianus</i> . |
| | <i>Mytilus edulis</i> . |
| Oysters: | |
| Eastern..... | <i>Ostrea virginica</i> . |
| Native..... | <i>Ostrea lurida</i> . |
| Scallops..... | <i>Pecten aquisulcatus</i> . |
| Snails..... | Gastropoda (species). |
| Octopus..... | <i>Polypus hongkongensis</i> . |
| Squid..... | <i>Loligo opalescens</i> . |

PRODUCTS.

The total yield of the fisheries of California in 1920 amounted to 212,635,075 pounds. The principal products were as follows: Pilchards, 118,517,729 pounds; albacore and tuna, 36,144,340 pounds; salmon, 11,077,014 pounds; bonito or skipjack, 8,614,581 pounds; flounders, 7,792,626 pounds; rockfishes, 5,503,187 pounds; and barracuda, 4,584,476 pounds. These products represent a total of 192,233,953 pounds, or 90.40 per cent of the total quantity credited to the State. The catch of shad amounted to 1,408,980 pounds; of sharks, skates, and rays to 1,253,648 pounds; of shrimp to 818,042 pounds; of squid to 507,751 pounds; of sea crawfish or spiny lobster to 247,156 pounds; of oysters to 148,924 pounds or 21,275 bushels; of octopus to 70,740 pounds; and of cockles to 18,054 pounds.

The imports of fresh fish from Mexico in 1920 amounted to 8,121,225 pounds. The principal products imported were as follows: Barracuda, 3,615,947 pounds; flounders, 1,678,264 pounds; sea crawfish or spiny lobster, 942,020 pounds; tuna, 724,281 pounds; white sea bass, or squeteague, 252,462 pounds; yellowtail, 218,400 pounds; and bonito or skipjack, 216,344 pounds.

PRODUCTS, IN POUNDS, OF THE FISHERIES OF CALIFORNIA, 1920.

| Species. | January. | February. | March. | April. | May. | June. | July. |
|---|------------|------------|------------|-----------|-----------|-----------|------------|
| Albacore and tuna... | 14,984 | 1,603 | 2,237 | ----- | 105 | 929,837 | 14,609,950 |
| Anchovies..... | 4,572 | 19,391 | 225 | 27,455 | 53,890 | 70,380 | 48,050 |
| Barracuda..... | 28,076 | 97,739 | 304,845 | 1,189,488 | 995,456 | 703,632 | 300,687 |
| Bluefish, California, or squeteague..... | 9,480 | 5,049 | 2,079 | ----- | ----- | ----- | ----- |
| Bonito or skipjack..... | 32,261 | 25,711 | 21,133 | 1,165 | 5,644 | 2,457 | 44,330 |
| Carp..... | 15,458 | 19,772 | 43,513 | 21,972 | 14,685 | 3,224 | 7,177 |
| Catfish..... | 5,599 | 7,532 | 20,880 | 37,464 | 19,533 | ----- | ----- |
| Flounders..... | 737,590 | 847,813 | 849,875 | 755,276 | 1,018,631 | 641,780 | 689,247 |
| Greenfish or rudder- fish..... | ----- | 412 | ----- | ----- | ----- | ----- | ----- |
| "Hake"..... | 5,500 | 2,030 | 3,170 | 6,527 | 13,138 | 17,860 | 14,510 |
| Hardhead..... | 2,753 | 3,565 | 4,688 | 1,350 | ----- | ----- | ----- |
| Herring..... | 76,632 | 80,707 | 59,177 | 810 | ----- | ----- | ----- |
| Kingfish..... | 125,104 | 18,269 | 46,779 | 85,637 | 38,302 | 16,742 | 7,774 |
| "Lingcod"..... | 160,109 | 45,729 | 52,324 | 19,332 | 37,203 | 37,149 | 90,166 |
| Mackerel..... | 104,689 | 176,424 | 75,667 | 466,318 | 242,550 | 270,228 | 136,205 |
| Mullet..... | 15,912 | 29 | 80 | ----- | ----- | 55 | 110 |
| "Perches," surf..... | 12,102 | 13,249 | 34,658 | 39,177 | 5,027 | 1,531 | 12,152 |
| Pike, Sacramento..... | 1,074 | 1,488 | 1,327 | 1,380 | 299 | 22 | 5 |
| Pilehard..... | 23,776,733 | 21,190,560 | 10,715,798 | 3,910,008 | 2,466,602 | 2,405,151 | 2,567,481 |
| Pompano, California..... | 2,523 | 2,607 | 6,435 | 6,250 | 1,880 | 689 | 594 |
| Rockfishes..... | 570,541 | 931,615 | 605,478 | 284,722 | 408,009 | 331,287 | 374,930 |
| Sablefish..... | 89,953 | 124,923 | 135,689 | 66,933 | 32,252 | 54,433 | 40,538 |
| Salmon..... | 27,048 | 70,012 | 238,160 | 783,721 | 1,108,955 | 1,097,138 | 2,648,203 |
| Sculpin..... | 2,387 | 515 | 2,866 | 3,978 | 7,882 | 1,076 | 419 |
| Sea bass, black..... | 5,533 | 6,031 | 14,565 | 19,284 | 3,085 | 5,418 | 7,935 |
| Sea basses or "rock bass"..... | 3,282 | 4,390 | 4,240 | 5,908 | 7,435 | 47,245 | 30,719 |
| Sea bass, white or squeteague..... | 15,423 | 285,230 | 109,340 | 364,401 | 313,808 | 256,675 | 200,232 |
| Shad..... | 925 | 3,093 | 91,529 | 597,250 | 713,905 | ----- | ----- |
| Sharks..... | 65,142 | 141,428 | 15,105 | 44,727 | 141,749 | 113,439 | 64,429 |
| Sheepshead..... | 4,199 | 4,336 | 65 | 1,088 | 56 | 7 | 370 |
| Skates..... | 13,434 | 5,819 | 23,907 | 6,777 | 3,480 | 7,262 | 1,719 |
| "Smelt"..... | 41,990 | 62,200 | 83,963 | 48,441 | 50,942 | 34,363 | 70,268 |
| Split-tail..... | 3,653 | 3,555 | 4,869 | 544 | ----- | ----- | ----- |
| Steelhead trout..... | ----- | ----- | ----- | 10 | ----- | ----- | 740 |
| Striped bass..... | 57,834 | 33,668 | 90,722 | 153,677 | 140,957 | 1,804 | ----- |
| Stingarees or sting- rays..... | ----- | ----- | ----- | 70,760 | 125,857 | 94,670 | 53,616 |
| Suckers..... | 695 | 444 | 429 | 563 | 30 | ----- | ----- |
| Surfish..... | ----- | ----- | ----- | ----- | 10 | ----- | ----- |
| Swordfish..... | 24 | ----- | ----- | ----- | ----- | 163 | 673 |
| Tomcod..... | 5,582 | 9,493 | 5,430 | 15 | 2,245 | 6,522 | 2,286 |
| Whitebait..... | ----- | 31 | 37 | ----- | 89 | 29 | ----- |
| Whitefish..... | 1,092 | 1,738 | 571 | 6 | ----- | ----- | ----- |
| Yellowtail..... | 55,943 | 20,497 | 189,208 | 231,788 | 216,719 | 173,808 | 48,404 |
| Other fish..... | 18,623 | 37,977 | 26,295 | 6,997 | 16,700 | 9,148 | 14,151 |
| Crabs..... | 307,780 | 146,542 | 104,038 | 73,018 | 161,106 | 55,132 | 6,292 |
| Shrimps..... | 68,204 | 52,545 | 62,147 | 117,711 | 90,569 | 42,729 | 86,696 |
| Sea crawfish or spiny lobster..... | 44,085 | 48,166 | ----- | ----- | ----- | ----- | ----- |
| Abalones..... | 13,088 | ----- | 30,362 | 53,535 | 75,145 | 96,588 | 150,285 |
| Clams..... | 41,226 | 39,725 | 40,677 | 49,035 | 43,999 | 51,675 | 59,951 |
| Cockles..... | 2,218 | 2,708 | 4,385 | 2,240 | 1,913 | 1,601 | 320 |
| Limpets..... | ----- | 55 | 480 | 1,200 | 1,400 | 7,900 | 3,900 |
| Mussels..... | 1,082 | 1,352 | 3,747 | 2,066 | 3,413 | 10,505 | 6,847 |
| Oysters: | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| Eastern..... | 9,099 | 9,344 | 6,040 | 7,974 | 6,205 | 4,629 | 4,200 |
| Native..... | 5,280 | 4,325 | 5,075 | 6,460 | 11,742 | 8,178 | 10,150 |
| Scallops..... | 50 | 246 | 217 | 212 | 34 | ----- | ----- |
| Snails..... | 273 | 280 | ----- | ----- | ----- | ----- | ----- |
| Octopus..... | 11,706 | 14,432 | 6,640 | 8,599 | 5,784 | 5,778 | 5,122 |
| Squid..... | 67,524 | 195,039 | 119,920 | ----- | 6,824 | 86,882 | 9,795 |
| Total..... | 26,687,519 | 24,827,820 | 14,271,086 | 9,583,280 | 8,635,444 | 7,706,821 | 22,431,653 |

PRODUCTS, IN POUNDS, OF THE FISHERIES OF CALIFORNIA, 1920—Continued.

| Species. | August. | September. | October. | November. | December. | Total. |
|--|------------|------------|------------|------------|-----------|-------------|
| Albacore and tuna..... | 14,819,308 | 3,801,885 | 1,954,324 | 8,948 | 1,159 | 36,144,340 |
| Anchovies..... | 16,485 | 199,577 | 87,561 | 28,405 | 14,695 | 570,686 |
| Barracuda..... | 219,553 | 308,899 | 285,362 | 53,022 | 97,717 | 4,584,476 |
| Bluefish, California, or squeteague..... | 54 | ..... | 6,724 | 6,045 | 2,798 | 32,229 |
| Bonito or skipjack..... | 3,058,975 | 3,784,239 | 1,474,619 | 112,557 | 51,490 | 1 8,614,581 |
| Carp..... | 340 | 150 | 302 | 1,614 | 6,213 | 134,420 |
| Catfish..... | 1,367 | 2,173 | 3,014 | 9,931 | 4,872 | 112,365 |
| Eels..... | ..... | ..... | 180 | ..... | ..... | 180 |
| Flounders..... | 563,746 | 515,164 | 371,617 | 389,434 | 412,453 | 7,792,626 |
| Greenfish or rudderfish..... | ..... | ..... | ..... | ..... | ..... | 412 |
| "Hake"..... | 7,110 | 14,079 | 16,207 | 29,925 | 11,925 | 141,981 |
| Hardhead..... | 470 | ..... | ..... | ..... | 467 | 13,323 |
| Herring..... | ..... | ..... | 130 | 303 | 47,605 | 274,364 |
| Kingfish..... | 3,442 | 8,728 | 23,477 | 30,980 | 35,968 | 461,411 |
| "Lingcod"..... | 72,105 | 47,725 | 50,019 | 45,847 | 30,246 | 687,954 |
| Mackerel..... | 306,088 | 383,946 | 306,474 | 188,653 | 340,066 | 2,997,308 |
| Mullet..... | 980 | 347 | ..... | ..... | ..... | 17,513 |
| "Perches," surf..... | 2,121 | 2,590 | 17,405 | 14,784 | 26,585 | 181,131 |
| Pike, Sacramento..... | 62 | 12 | ..... | 899 | 1,570 | 8,138 |
| Pilehead..... | 13,130,386 | 14,163,733 | 11,102,753 | 8,990,053 | 4,098,151 | 118,517,729 |
| Pompano, California..... | 75 | 883 | 6,436 | 1,060 | 719 | 30,126 |
| Rockfishes..... | 298,448 | 285,248 | 321,742 | 421,234 | 669,933 | 5,503,187 |
| Sablefish..... | 45,386 | 9,233 | 67,814 | 86,772 | 27,106 | 781,032 |
| Salmon..... | 2,862,287 | 1,879,429 | 152,691 | 172,114 | 37,226 | 11,077,014 |
| Sculpin..... | 22 | 1,610 | 7,451 | 2,367 | 5,101 | 35,674 |
| Sea bass, black..... | 4,215 | 4,784 | 6,552 | 7,026 | 5,441 | 89,869 |
| Sea basses or "rock bass"..... | 28,742 | 27,715 | 23,665 | 12,059 | 11,675 | 207,075 |
| Sea bass, white or squeteague..... | 443,558 | 263,553 | 42,526 | 45,651 | 35,896 | 2,376,293 |
| Shad..... | 1,169 | 188 | ..... | 639 | 282 | 1,408,980 |
| Sharks..... | 45,319 | 39,153 | 30,414 | 41,154 | 56,662 | 798,721 |
| Sheepshead..... | 280 | 107 | 877 | 1,027 | 1,990 | 14,402 |
| Skates..... | 437 | 6,774 | 1,020 | 6,650 | 11,652 | 88,931 |
| "Smelt"..... | 59,727 | 76,895 | 77,129 | 82,057 | 42,491 | 730,475 |
| Split-tail..... | ..... | 23 | ..... | 288 | 1,154 | 14,084 |
| Steelhead trout..... | 5,160 | ..... | ..... | 425 | 664 | 6,999 |
| Striped bass..... | 39,701 | 48,080 | ..... | 37,204 | 66,084 | 671,731 |
| Stingarees or stingrays..... | 14,195 | 5,383 | 665 | ..... | 820 | 365,996 |
| Suckers..... | ..... | ..... | 264 | 287 | ..... | 2,712 |
| Surfsculpin..... | ..... | ..... | ..... | ..... | ..... | 10 |
| Swordfish..... | 2,600 | 5,812 | 2,598 | 370 | ..... | 12,240 |
| Tomcod..... | 606 | 128 | ..... | 1,884 | 3,046 | 37,237 |
| Whitebait..... | ..... | ..... | 8 | 147 | 387 | 738 |
| Whitefish..... | 90 | ..... | 20 | 1,517 | 2,385 | 7,419 |
| Yellowtail..... | 108,582 | 250,128 | 632,753 | 463,334 | 84,119 | 2,475,283 |
| Other fish..... | 18,921 | 6,082 | 28,988 | 54,002 | 19,054 | 256,938 |
| Crabs..... | ..... | ..... | ..... | 96,074 | 165,880 | 2 1,115,862 |
| Shrimps..... | 82,015 | 141,048 | 32,955 | 24,148 | 17,275 | 818,012 |
| Sea crawfish or spiny lobster..... | ..... | ..... | 40,500 | 68,861 | 49,935 | 247,156 |
| Abalones..... | 105,061 | 59,365 | 55,859 | 95,430 | 71,998 | 806,716 |
| Clams..... | 42,245 | 58,659 | 51,662 | 45,370 | 44,181 | 568,405 |
| Cockles..... | 550 | 167 | 75 | 76 | 1,801 | 18,054 |
| Limpets..... | 3,900 | ..... | ..... | ..... | ..... | 18,835 |
| Mussels..... | 3,070 | 139 | 140 | 224 | 125 | 32,710 |
| Oysters: | ..... | ..... | ..... | ..... | ..... | ..... |
| Eastern..... | 5,229 | 6,751 | 8,976 | 8,997 | 10,839 | 3 89,183 |
| Native..... | 4,594 | 2,082 | 1,575 | 330 | ..... | 59,741 |
| Scallops..... | ..... | ..... | 175 | 60 | ..... | 759 |
| Snails..... | ..... | ..... | ..... | ..... | ..... | 788 |
| Octopus..... | 4,102 | 375 | 2,199 | 3,207 | 2,796 | 70,740 |
| Squid..... | 21,292 | ..... | ..... | 322 | 53 | 507,751 |
| Total..... | 36,454,270 | 26,413,036 | 17,297,606 | 11,693,776 | 6,632,750 | 212,635,075 |

¹ This item may include some striped tuna.² 50,721 in number.³ 5,096,182 in number.

MEXICAN FISHERY PRODUCTS, IN POUNDS, IMPORTED INTO CALIFORNIA, 1920.

| Species. | January. | February. | March. | April. | May. | June. | July. |
|-------------------------------------|-----------|-----------|---------|---------|---------|---------|---------|
| Barracuda..... | 651,055 | 480,903 | 608,706 | 21,604 | ----- | ----- | 1,615 |
| Bonito or skipjack..... | 106,050 | 31,085 | 1,955 | 10,844 | ----- | ----- | ----- |
| Flounders..... | 104,938 | 160,078 | 87,377 | 61,529 | 48,180 | 12,980 | 100,674 |
| Mackerel..... | 28,056 | 3,450 | 745 | 515 | ----- | ----- | ----- |
| "Perches," surf..... | 40 | 250 | ----- | ----- | ----- | ----- | ----- |
| Pilehard..... | ----- | ----- | 3,181 | ----- | ----- | ----- | ----- |
| Pompano, California..... | 80 | 89 | 62 | ----- | ----- | ----- | ----- |
| Rockfishes..... | 2,210 | 80,099 | 1,620 | ----- | ----- | 170 | ----- |
| Sea basses or "rock bass"..... | 125 | 190 | 315 | ----- | ----- | 210 | ----- |
| Sea bass, black..... | 8,063 | 9,757 | 9,398 | 550 | ----- | ----- | 2,412 |
| Sea bass, white, or squeteague..... | 23,900 | 23,343 | 5,478 | 3,505 | 1,560 | 4,780 | 26,497 |
| Sharks..... | ----- | ----- | 12,628 | ----- | ----- | ----- | ----- |
| "Smelt"..... | 39 | ----- | ----- | ----- | ----- | ----- | ----- |
| Stingarees or stingrays..... | ----- | ----- | 24,885 | ----- | ----- | ----- | ----- |
| Swordfish..... | ----- | ----- | ----- | ----- | ----- | 273 | ----- |
| Tuna..... | ----- | ----- | ----- | 122,316 | 375,647 | ----- | ----- |
| Whitefish..... | ----- | 2,137 | 2,280 | ----- | ----- | ----- | ----- |
| Yellowtail..... | 24,517 | 14,793 | 29,528 | 15,845 | ----- | 5,045 | 915 |
| Other fish..... | 630 | ----- | ----- | ----- | ----- | ----- | ----- |
| Sea crawfish or spiny lobster..... | 77,440 | 103,508 | 136,008 | 131,030 | 118,408 | 71,305 | ----- |
| Abalones..... | 20,200 | ----- | 9,750 | 1,509 | ----- | ----- | 16,642 |
| Clams..... | 12,900 | 5,600 | ----- | 4,827 | ----- | 2,230 | ----- |
| Turtles..... | ----- | ----- | 2,180 | ----- | ----- | 38,399 | 34,039 |
| Total..... | 1,000,245 | 915,282 | 936,100 | 871,074 | 543,795 | 135,392 | 182,794 |

| Species. | August. | Septem-ber. | October. | Novem-ber. | Decem-ber. | Total. |
|-------------------------------------|---------|-------------|-----------|------------|------------|-----------|
| Barracuda..... | 147,511 | 173,622 | 531,107 | 543,124 | 456,700 | 3,615,947 |
| Bonito or skipjack..... | 798 | 11,028 | 18,539 | 20,038 | 16,007 | 216,344 |
| Flounders..... | 220,603 | 297,907 | 432,770 | 106,278 | 35,950 | 1,678,264 |
| Kingfish..... | ----- | ----- | 48 | ----- | ----- | 48 |
| Mackerel..... | 1,912 | 5,230 | 8,895 | 390 | 1,539 | 50,732 |
| Mullet..... | 90 | ----- | ----- | ----- | ----- | 90 |
| "Perches," surf..... | ----- | ----- | 50 | 670 | 4,230 | 5,240 |
| Pilehard..... | ----- | ----- | ----- | ----- | ----- | 3,185 |
| Pompano, California..... | ----- | ----- | ----- | ----- | ----- | 231 |
| Rockfishes..... | 1,745 | 885 | 1,733 | 9,000 | 190 | 97,661 |
| Sea basses or "rock bass"..... | ----- | 485 | 75 | 1,090 | 815 | 3,305 |
| Sea bass, black..... | 1,858 | 2,018 | 6,923 | 4,397 | 12,792 | 58,168 |
| Sea bass, white, or squeteague..... | 90,245 | 41,414 | 20,360 | 9,174 | 2,206 | 252,462 |
| Sharks..... | ----- | ----- | ----- | ----- | ----- | 12,628 |
| Sheepshead..... | ----- | 165 | ----- | ----- | ----- | 165 |
| "Smelt"..... | 500 | 171 | 966 | 6,396 | 5,640 | 13,712 |
| Stingarees or stingrays..... | ----- | ----- | ----- | ----- | ----- | 24,885 |
| Swordfish..... | ----- | ----- | ----- | ----- | ----- | 273 |
| Tuna..... | ----- | 200,415 | 16,278 | ----- | 9,625 | 724,281 |
| Whitefish..... | ----- | ----- | ----- | 435 | ----- | 4,852 |
| Yellowtail..... | 3,952 | 26,870 | 48,535 | 43,140 | 5,260 | 218,400 |
| Other fish..... | ----- | ----- | ----- | ----- | ----- | 630 |
| Sea crawfish or spiny lobster..... | ----- | 22,443 | 90,590 | 105,330 | 85,958 | 942,020 |
| Abalones..... | 11,287 | 7,367 | 19,317 | 6,651 | 2,387 | 95,110 |
| Clams..... | ----- | ----- | ----- | ----- | ----- | 25,557 |
| Turtles..... | ----- | 2,300 | ----- | ----- | ----- | 76,918 |
| Total..... | 489,501 | 702,500 | 1,196,123 | 856,122 | 639,299 | 8,121,225 |

FISHERIES OF THE SOUTH ATLANTIC STATES IN 1918.

The statistics of the fisheries contained in this report apply to the commercial coast fisheries of North Carolina, South Carolina, Georgia, and the eastern coast of Florida for the calendar year, 1918.^a The results of a similar canvass of the fisheries of the Gulf States in 1918, including the western coast of Florida, are included in "Fishery Industries of the United States. Report of the Division of Statistics and Methods of the Fisheries for 1919," pages 129 to 191.

^a The data were collected by Winthrop A. Roberts and Rob Leon Greer, assisted in North Carolina by Arthur Orr, E. M. Haynes, and G. W. Hoofnagle.

EARLIER PUBLICATIONS.

Some of the earlier publications relating to the fisheries of the South Atlantic States and published in Washington, D. C., follow:

1887. North Carolina and Its Fisheries. By R. Edward Earll. *In* The Fisheries and Fishery Industries of the United States, by G. Brown Goode et al., Sec. II, Pt. XII, p. 475-497.
The Fisheries of South Carolina and Georgia. By R. Edward Earll. *Ibid.*, Sec. II, Pt. XIII, p. 499-518.
Eastern Florida and Its Fisheries. By R. Edward Earll. *Ibid.*, Sec. II, Pt. XIV, p. 519-531.
History and Methods of the Fisheries. *Ibid.*, Sec. V, Vol. I (xi+808 p.), Vol. II (xx+881 p.), and atlas of 275 pls.
1892. V. The Fisheries of the South Atlantic States [1887 and 1888]. *In* Statistical Review of the Coast Fisheries of the United States, prepared under the direction of J. W. Collins. Report, U. S. Commission of Fish and Fisheries, 1888 (1892), p. 351-361.
1893. Report on the Fisheries of the South Atlantic States. By Hugh M. Smith. Bulletin, U. S. Fish Commission, Vol. XI, 1891 (1893), p. 269-356, Pl. XLIII-LXXIV.
1897. Report on the Fisheries of Indian River, Florida. By John J. Brice et al. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), p. 223-262, pl. 23-59.
1898. Report on the Fish and Fisheries of the Coastal Waters of Florida. By John J. Brice. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), p. 263-342.
1899. Notes on the Extent and Condition of the Alewife Fisheries of the United States in 1896. By Hugh M. Smith. Report, U. S. Commission of Fish and Fisheries, 1898 (1899), p. 31-43.
The Shad Fisheries of the Atlantic Coast of the United States. By Charles H. Stevenson. *Ibid.*, p. 101-176.
1900. Statistics of the Fisheries of the South Atlantic States [1897]. Report, U. S. Commission of Fish and Fisheries, 1899 (1900), p. 171-227.
1905. Statistics of the South Atlantic States, 1902. Report, U. S. Commission of Fish and Fisheries, 1903 (1905), p. 343-410.
1911. Fisheries of the United States, 1908. Special Reports, Bureau of the Census, 1911.

COMMON AND SCIENTIFIC NAMES OF FISHES.

In the appended list are given the common and scientific names of the species of fishes of the South Atlantic States listed in the statistical tables, as accurately as it has been practicable to determine them, for the guidance of the reader.

| | |
|------------------------------|-------------------------------------|
| Alewives..... | { <i>Pomolobus astivalis</i> . |
| | { <i>Pomolobus pseudoharengus</i> . |
| Amberfish..... | <i>Seriola</i> (species). |
| Angelfish..... | <i>Chaetodipterus faber</i> . |
| Barracuda..... | <i>Sphyræna</i> (species). |
| | { <i>Micropterus dolomieu</i> . |
| Black bass..... | { <i>Micropterus salmoides</i> . |
| Bluefish..... | <i>Pomatomus saltatrix</i> . |
| Blue runner or hardtail..... | <i>Caranx crysos</i> . |
| Bonito..... | <i>Sarda sarda</i> . |
| Bowfin..... | <i>Amiatus calvus</i> . |
| Butterfish..... | <i>Poronotus triacanthus</i> . |
| Carp..... | <i>Cyprinus carpio</i> . |
| Catfish..... | <i>Siluridæ</i> (species). |
| | { <i>Scomberomorus cavalla</i> . |
| Cero and kingfish..... | { <i>Scomberomorus regalis</i> . |
| Cowfish and "shellfish"..... | <i>Ostraciidæ</i> (species). |
| Crappie..... | <i>Pomoxis sparoides</i> . |
| Crevalle..... | <i>Caranx</i> (species). |
| Croaker..... | <i>Micropogon undulatus</i> . |

| | |
|-----------------------------------|--|
| Drum, red and black..... | { <i>Sciaenops ocellatus</i> . |
| Eels..... | { <i>Pogonias cromis</i> . |
| Flounders..... | { <i>Anguilla rostrata</i> . |
| Gizzard shad..... | { Other Apodes. |
| Groupers..... | Pleuronectidæ (species). |
| Grunts..... | <i>Dorosoma cepedianum</i> . |
| Hickory shad..... | <i>Epinephelus</i> (species). |
| Hogfish..... | <i>Mycteroperca</i> (species). |
| Jewfish..... | <i>Garrupa nigrita</i> . |
| King whiting..... | Hæmulidæ (species). |
| Ladyfish..... | <i>Pomolobus mediocris</i> . |
| Leather jacket or "turbot"..... | <i>Lachnolaimus maximus</i> . |
| Menhaden..... | <i>Promicrops guttatus</i> . |
| Moonfish..... | <i>Menticirrhus</i> (species). |
| Mullet..... | <i>Albula vulpes</i> . |
| Parrotfish..... | <i>Balistes carolinensis</i> . |
| Perch, white..... | <i>Brevoortia tyrannus</i> . |
| Perch, yellow..... | <i>Vomer setipinnis</i> . |
| Permit..... | { <i>Mugil cephalus</i> . |
| Pigfish..... | { <i>Mugil curema</i> . |
| Pike or pickerel..... | Scaridæ (species). |
| Pinfish or sailor's choice..... | <i>Morone americana</i> . |
| Pompano..... | <i>Perca flavescens</i> . |
| Porgies (Gulf)..... | <i>Trachinotus goodiei</i> . |
| Porkfish..... | <i>Orthopristis chrysopterus</i> . |
| Scup..... | <i>Esox</i> (species). |
| Sea bass..... | { <i>Lagodon rhomboides</i> . |
| Sea gar or needlefish..... | { Other species. |
| Sergeantfish or snook..... | <i>Trachinotus carolinus</i> . |
| Shad..... | <i>Trachinotus</i> (other species). |
| Sharks..... | (See also Permit.) |
| Sheepshead..... | <i>Calamus</i> (species). |
| Skates..... | <i>Pagrus</i> (species). |
| Snapper, mangrove..... | <i>Anisotremus virginicus</i> . |
| Snapper, mutton..... | <i>Stenotomus</i> (species). |
| Snapper, red..... | <i>Centropomus striatus</i> . |
| Spanish mackerel..... | { <i>Tylosurus</i> (species). |
| Spot..... | { <i>Ablennes</i> (species). |
| Squeteagues or "sea trout"..... | <i>Centropomus undecimalis</i> . |
| Striped bass..... | <i>Alosa sapidissima</i> . |
| Sturgeon..... | <i>Acipenser sturio</i> . |
| Suckers..... | Castostomidæ (species). |
| Sunfish..... | Centrarchidæ (species). |
| Tautog..... | <i>Tautoga onitis</i> . |
| Tilefish..... | <i>Lopholatilus chamaeleonticeps</i> . |
| Yellowtail or "silver perch"..... | <i>Bairdiella chrysura</i> . |

GENERAL STATISTICS

The number of persons engaged in the fisheries of the South Atlantic States in 1918 was 15,046, of whom 1,964 were on vessels fishing, 91 on vessels transporting fishery products, 8,604 in shore fisheries, and 4,387 shoremen in the wholesale fishery trade, oyster canneries, fertilizer factories, and other industries connected with

the fisheries. Of the total, 8,036 are credited to North Carolina, 2,000 to South Carolina, 1,680 to Georgia, and 3,330 to the east coast of Florida.

Compared with the returns for 1902, there has been a decrease in the number of persons employed in North Carolina of 6,719, or 45.54 per cent; in South Carolina, a decrease of 1,713, or 46.14 per cent; in Georgia, a decrease of 606, or 26.51 per cent, and in Florida, an increase of 632 persons, or 23.42 per cent. The total decrease for the entire region amounts to 8,406, or 35.84 per cent.

The capital invested in the fisheries of this region amounted to \$7,423,971, distributed as follows: North Carolina, \$4,222,043; South Carolina, \$221,251; Georgia, \$769,998; and the east coast of Florida, \$2,210,679. The investment included 261 fishing and transporting vessels, valued at \$1,855,588 and having a net tonnage of 5,597 tons and outfits valued at \$565,858; 5,632 boats, valued at \$910,218; fishing apparatus used by vessels and boats, valued at \$957,239; shore and accessory property to the value of \$2,731,918; and cash capital to the amount of \$403,150.

Compared with 1902, there has been an increase in the investment in North Carolina amounting to \$2,248,602, or 113.94 per cent; in South Carolina, a decrease of \$99,472, or 31.01 per cent; in Georgia, an increase of \$427,848, or 125.04 per cent, and on the east coast of Florida, an increase of \$1,855,844, or 523.01 per cent, representing a total increase for the region of \$4,432,822, or 148.19 per cent.

The principal forms of fishing apparatus arranged in order of their value were: 3,779 pound nets, valued at \$355,439; 15,399 gill nets, valued at \$233,883; 91 purse seines, valued at \$219,027; 582 haul seines, valued at \$102,193; and 371 otter trawls, valued at \$22,055. Other apparatus employed included fyke nets, dredges, lines, cast nets, stop nets, eel pots, tongs, grabs, rakes, spears, etc., to the value of \$24,642. The use of the otter trawl introduced in the shrimp fishery at Fernandina, Fla., about 1915, represents the most important change in fishing apparatus since 1902.

The products of the fisheries amounted to 332,614,123 pounds, having a value to the fishermen of \$5,348,616. The yield of the various States was as follows: North Carolina, 210,501,750 pounds, valued at \$2,978,708; South Carolina, 3,746,932 pounds, valued at \$207,690; Georgia, 37,153,953 pounds, valued at \$416,043; and east coast of Florida, 81,211,488 pounds, valued at \$1,746,175.

The more important species taken in these States were: Alewives, fresh and salted, taken mostly in North Carolina, 15,185,585 pounds, valued at \$412,067; black bass, credited to North Carolina, 551,125 pounds, valued at \$63,137; bluefish, 892,045 pounds, valued at \$85,567; cero and kingfish, taken mostly in Florida, 2,483,647 pounds, valued at \$161,562; menhaden, 257,757,799 pounds, valued at \$1,605,117; mullet, fresh and salted, 11,757,318 pounds, valued at \$508,044; sea bass, 577,596 pounds, valued at \$50,592; shad, 2,888,644 pounds, valued at \$568,585; Spanish mackerel, credited mostly to Florida, 3,211,405 pounds, valued at \$232,355; spot, 1,692,775 pounds, valued at \$72,795; squeteagues or "sea trout," 5,105,249 pounds, valued at \$360,527; shrimp, 15,656,903 pounds, valued at \$470,346; and oysters, 5,871,376 pounds, or 838,768 bushels, valued at \$260,863.

Compared with the Bureau's returns for 1902, there has been an increase in the products of the fisheries of 226,168,051 pounds, or 212.47 per cent, in quantity and of \$2,508,983, or 88.35 per cent, in value. Compared with the census returns for 1908, the increase

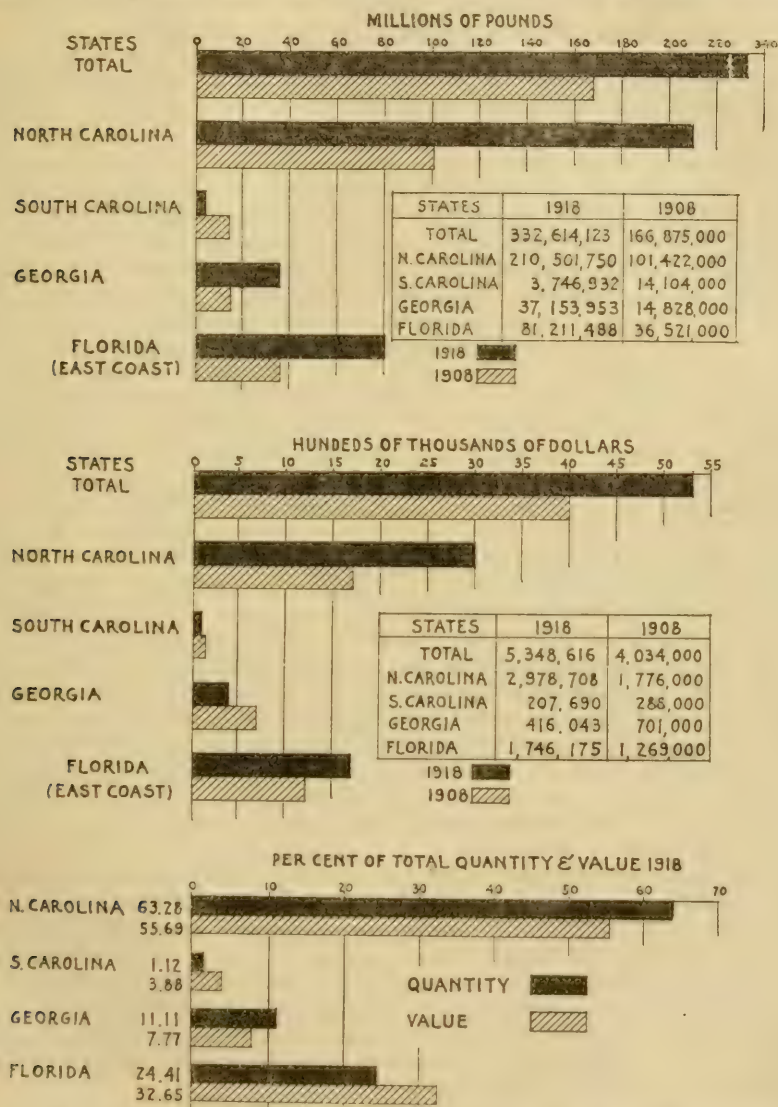


FIG. 7.—Top: Quantities of fish taken in the commercial fisheries of the South Atlantic States in 1918 compared with 1908. Center: Values of fish taken in the commercial fisheries of the South Atlantic States in 1918 compared with 1908. Bottom: Percentages of total quantity and value of fishery products for each of the South Atlantic States in 1918.

amounts to 165,739,123 pounds, or 99.31 per cent, in quantity and \$1,314,616, or 32.58 per cent, in value. The large increase in the catch for 1918 over that of previous years is due to the increase in the catch of menhaden, the 1902 catch amounting to 18,862,000 pounds, valued at \$31,420. The catch of other species in 1902

amounted to \$7,584,072 pounds, valued at \$2,808,213, and in 1918 to 74,856,324 pounds, valued at \$3,743,499, a decrease of 14.53 per cent in quantity and an increase of 33.30 per cent in value. Compared with 1902 the increase in North Carolina amounted to 142,917,016 pounds, or 211.46 per cent, in quantity and \$1,239,047, or 71.22 per cent, in value; in Georgia, to 26,051,343 pounds, or 234.64 per cent, in quantity and \$56,962, or 15.86 per cent, in value; and on the east coast of Florida, to 61,627,223 pounds, or 314.67 per cent, in quantity and \$1,268,307, or 265.41 per cent, in value. In South Carolina there was a decrease in the quantity amounting to 4,427,531 pounds, or 54.16 per cent, and in value of \$55,333, or 21.03 per cent.

As an index of the trend of the fisheries of the South Atlantic States it is of interest to compare for various years from 1890 to 1918 the catch of certain staple species with the take of forms which have increased greatly in importance in recent years, species of which in the past there has been a comparative abundance but a lack of demand. For this purpose alewives, mullet, shad, squeteagues, and oysters have been selected as representative of staple varieties and cero (including kingfish), red and black drum, menhaden, Spanish mackerel, and shrimp, representing species for which the demand has greatly increased in recent years, resulting in much more intensive fishing operations. Lacking accurate data, for comparative purposes, as to the intensiveness with which these fisheries were prosecuted, it is difficult to draw definite conclusions regarding the present status of these fisheries, but the figures are nevertheless of interest. A study of the appended table reveals comparatively small fluctuations in the catch of alewives over the entire period. The fishery for mullet has more than doubled since 1890 but shows a reduction in the catch in 1918 as compared with 1902 and 1908. That the supply of shad is being depleted is indicated by the striking reduction in the catch in 1918 in comparison with that for other years. In comparison with 1908, the decrease amounts to 5,683,356 pounds, or 66.30 per cent. The fluctuation in the catch of squeteagues is not so marked, and in the absence of accurate information as to the intensiveness of fishing operations for the various years, the status of this fishery is largely conjectural. As on other parts of the coast, there has been a striking decline in the take of oysters.

With greater development of the fisheries and inability to supply the demand for staple varieties, the growth of other fisheries has been quite striking as indicated by the statistics for cero and kingfish, red and black drum, Spanish mackerel, and shrimp. On the Atlantic seaboard, the demand for red drum or "channel bass," as it is often called, has never been as great as on the Gulf and difficulty has been experienced in marketing it, particularly in the more northern part of its range. The increased catch of menhaden for conversion into oil and scrap is also of interest.

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE SOUTH ATLANTIC STATES, VARIOUS YEARS, 1890 TO 1918.

| Year. | Alewives. | Mullet. | Shad. | Squeteague or sea trout. | Oysters. |
|-----------|------------|------------|------------|-----------------------------|------------|
| 1890..... | 16,543,783 | 5,573,623 | 9,385,354 | 2,368,067 | 8,344,805 |
| 1897..... | 15,856,350 | 5,934,942 | 11,268,343 | 3,741,274 | 11,285,268 |
| 1902..... | 11,601,172 | 14,310,808 | 9,849,338 | 4,848,269 | 22,719,074 |
| 1908..... | 12,180,000 | 14,501,800 | 8,572,000 | 8,615,000 | 30,549,000 |
| 1918..... | 15,185,585 | 11,757,318 | 2,888,644 | 5,105,249 | 5,871,376 |

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE SOUTH ATLANTIC STATES.
VARIOUS YEARS, 1890 TO 1918—Continued.

| Year. | Cero and kingfish. | Drum, red and black. | Menhaden. | Spanish mackerel. | Shrimp. |
|-----------|--------------------|----------------------|-------------|-------------------|------------|
| 1890..... | | 692,003 | 12,410,400 | | 744,025 |
| 1897..... | 358,070 | 772,032 | 11,310,000 | 362,390 | 627,221 |
| 1902..... | 77,170 | 583,394 | 18,862,000 | 1,013,172 | 3,810,641 |
| 1908..... | | 1,421,000 | 57,412,000 | 1,685,000 | 5,697,000 |
| 1918..... | 2,483,647 | 1,007,311 | 257,757,799 | 3,211,405 | 15,656,903 |

As indicative of the trend of important fisheries common to the South Atlantic and Gulf coasts the following table is of interest. In view of the present high degree of development of the fisheries in these sections, it is becoming increasingly important that frequent statistical inventories be made to supply information as to whether these fisheries are being endangered and as to the needs for restrictive measures to safeguard the harvests of the future.

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE SOUTH ATLANTIC AND GULF STATES, VARIOUS YEARS, 1890 TO 1918.

| Year. | Mullet. | Spanish mackerel. | Squeteague or sea trout. | Shrimp. | Oysters. |
|-----------|------------|-------------------|--------------------------|------------|------------|
| 1890..... | 20,758,740 | 700,450 | 5,327,500 | 8,195,375 | 28,931,003 |
| 1897..... | 21,286,828 | 1,089,066 | 6,835,377 | 7,418,246 | 27,942,406 |
| 1902..... | 41,544,130 | 2,597,063 | 9,637,316 | 10,177,551 | 56,835,009 |
| 1908..... | 33,354,800 | 3,171,000 | 12,705,000 | 18,258,001 | 74,952,000 |
| 1918..... | 40,398,682 | 6,706,250 | 10,065,987 | 42,799,902 | 29,625,841 |

The following tables contain statistics of the number of persons employed, the amount of capital invested, the quantity and value of the products of the fisheries of the South Atlantic States in 1918, and comparative statistics of persons, investment, and products for various years from 1880 to 1918.

FISHERIES OF THE SOUTH ATLANTIC STATES, 1918.

| Item. | North Carolina. | | South Carolina. | |
|------------------------------|-----------------|-----------|-----------------|---------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 1,295 | | 103 | |
| On vessels transporting..... | 54 | | 20 | |
| In shore fisheries..... | 4,993 | | 1,121 | |
| Shoresmen..... | 1,784 | | 756 | |
| Total..... | 8,036 | | 2,000 | |
| INVESTMENT. | | | | |
| Vessel fishing: | | | | |
| Steam..... | 15 | \$507,315 | | |
| Tonnage..... | 1,791 | | | |
| Outfit..... | | 206,685 | | |
| Gasoline..... | 55 | 413,710 | 3 | \$7,005 |
| Tonnage..... | 1,258 | | 74 | |
| Outfit..... | | 160,360 | | 2,075 |
| Sail..... | 48 | 28,700 | 33 | 20,995 |
| Tonnage..... | 388 | | 357 | |
| Outfit..... | | 9,745 | | 4,415 |
| Vessel transporting: | | | | |
| Gasoline..... | 25 | 24,600 | 7 | 11,000 |
| Tonnage..... | 197 | | 74 | |
| Outfit..... | | 13,775 | | 1,350 |
| Sail..... | 12 | 9,700 | | |
| Tonnage..... | 92 | | | |
| Outfit..... | | 4,450 | | |

FISHERIES OF THE SOUTH ATLANTIC STATES, 1918—Continued.

| Item. | North Carolina. | | South Carolina. | |
|-------------------------------|-----------------|-----------|-----------------|----------|
| | Number. | Value. | Number. | Value. |
| INVESTMENT—continued. | | | | |
| Boats: | | | | |
| Sail, row, etc. | 1,727 | \$33,053 | 639 | \$15,810 |
| Power. | 1,357 | 269,720 | 51 | 20,600 |
| Apparatus, vessel fisheries: | | | | |
| Purse seines. | 57 | 156,727 | | |
| Gill nets. | 13 | 800 | | |
| Lines. | | 50 | | 100 |
| Otter trawls. | 2 | 100 | | |
| Dredges. | 86 | 2,655 | | |
| Tongs and grabs. | 22 | 100 | 165 | 527 |
| Apparatus, shore fisheries: | | | | |
| Purse seines. | 3 | 1,600 | | |
| Haul seines. | 440 | 41,533 | 25 | 2,550 |
| Gill nets. | 14,299 | 108,878 | 233 | 16,525 |
| Pound nets. | 3,779 | 355,439 | | |
| Fyke nets. | 591 | 6,230 | | |
| Cast nets. | | | 71 | 155 |
| Stop nets. | 6 | 90 | 2 | 130 |
| Lines. | | 333 | | 515 |
| Otter trawls. | 27 | 960 | 2 | 90 |
| Eel pots. | 1,585 | 1,329 | | |
| Dredges. | 550 | 2,648 | | |
| Tongs, grabs, and rakes. | 1,008 | 2,046 | 549 | 1,482 |
| Spears or gigs. | 80 | 78 | 36 | 27 |
| Crab traps and drags. | 113 | 565 | | |
| Other apparatus. | | 375 | | 25 |
| Shore and accessory property. | | 1,347,644 | | 95,775 |
| Cash capital. | | 159,050 | | 20,100 |
| Total. | | 4,222,043 | | 221,251 |
| PRODUCTS. | | | | |
| Alewives: | Pounds. | Value. | Pounds. | Value. |
| Fresh. | 8,739,944 | \$238,624 | 9,500 | \$475 |
| Salted. | 5,743,876 | 162,595 | | |
| Angelfish. | 8,975 | 340 | | |
| Black bass. | 551,125 | 63,177 | | |
| Bluefish. | 322,744 | 29,677 | 3,000 | 275 |
| Bonito. | 3,015 | 107 | | |
| Bowfin. | 34,372 | 319 | | |
| Butterfish. | 731,257 | 24,785 | 600 | 45 |
| Carp. | 153,169 | 5,619 | | |
| Catfish. | 304,509 | 9,783 | 2,900 | 108 |
| Cero and Kingfish. | 211,781 | 13,947 | | |
| Crappie. | 5,340 | 568 | | |
| Cresvalle. | 201 | 11 | 300 | 65 |
| Croaker. | 386,807 | 11,912 | 16,000 | 1,062 |
| Drum, red and black. | 99,546 | 3,246 | 6,000 | 285 |
| Eels. | 174,541 | 13,333 | | |
| Flounders. | 91,121 | 7,022 | 16,200 | 1,061 |
| Gizzard shad. | 44,525 | 1,154 | | |
| Grunts. | 15,000 | 1,150 | 100 | 6 |
| Hickory shad. | 158,443 | 13,388 | 20,500 | 2,000 |
| King whiting. | | | 40,125 | 4,707 |
| Menhaden. | 179,910,599 | 1,306,489 | | |
| Mullet: | | | | |
| Fresh. | 812,679 | 52,734 | 58,050 | 4,223 |
| Salted. | 315,350 | 38,341 | 142,700 | 14,906 |
| Perch: | | | | |
| White. | 617,088 | 31,150 | | |
| Yellow. | 223,813 | 10,147 | | |
| Pigfish: | | | | |
| Fresh. | 264,272 | 12,675 | | |
| Salted. | 3,125 | 63 | | |
| Pike. | 20,552 | 1,898 | | |
| Pinfish or sailor's choice. | 50,179 | 1,225 | 2,300 | 148 |
| Pompano. | 8,685 | 994 | | |
| Porgies. | | | 2,000 | 130 |
| Sea bass. | 111,650 | 10,928 | 132,000 | 13,200 |
| Shad. | 1,657,036 | 376,696 | 167,462 | 29,085 |
| Sharks. | | | 20,000 | 175 |
| Sheepshead. | 26,223 | 1,839 | 2,100 | 210 |
| Skates. | | | 2,000 | 15 |
| Spanish mackerel. | 149,440 | 14,270 | | |
| Spot: | | | | |
| Fresh. | 1,193,270 | 52,531 | 37,000 | 2,354 |
| Salted. | 42,825 | 3,768 | 25,550 | 2,085 |
| Squeteagues or "sea trout": | | | | |
| Fresh. | 3,361,246 | 209,483 | 59,150 | 4,846 |
| Salted. | 80 | 10 | | |
| Striped bass. | 286,528 | 46,030 | | |
| Sturgeon. | 6,916 | 974 | 117,225 | 21,136 |
| Sturgeon caviar. | 671 | 1,497 | 665 | 889 |

FISHERIES OF THE SOUTH ATLANTIC STATES, 1918—Continued.

| Item. | North Carolina. | | South Carolina. | |
|-----------------------------------|-----------------|-----------|-----------------|---------|
| PRODUCTS—continued. | Pounds. | Value. | Pounds. | Value. |
| Suckers..... | 16,464 | \$680 | | |
| Sunfish..... | 123,980 | 1,202 | 3,000 | \$180 |
| Tautog..... | 150 | 9 | | |
| Yellowtail or "silver perch"..... | 31,278 | 1,379 | 900 | 37 |
| Shrimp..... | 940,120 | 23,485 | 55,400 | 6,220 |
| Crabs: | | | | |
| Hard..... | 145,605 | 1,983 | 18,000 | 400 |
| Soft..... | 233,705 | 23,821 | 300 | 75 |
| Clams, hard..... | 197,576 | 46,598 | 800 | 200 |
| Oysters, market: | | | | |
| Public..... | 1,500,534 | 67,380 | 2,631,755 | 83,892 |
| Private..... | 18,200 | 2,900 | 152,075 | 12,650 |
| Scallops..... | 422,832 | 31,618 | | |
| Terrapin..... | 210 | 92 | 1,275 | 545 |
| Turtles..... | 8,400 | 77 | | |
| Shark hides..... | 19,125 | 2,868 | | |
| Other aquatic hides..... | 1,050 | 157 | | |
| Total..... | 210,501,750 | 2,978,708 | 3,746,932 | 207,690 |

| Item. | Georgia. | | Florida (east coast). | | Total. | |
|-----------------------------------|----------|-----------|-----------------------|-----------|---------|-----------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 186 | | 380 | | 1,964 | |
| On vessels transporting..... | 2 | | 15 | | 91 | |
| In shore fisheries..... | 476 | | 2,104 | | 8,604 | |
| Shoresmen..... | 1,016 | | 831 | | 4,387 | |
| Total..... | 1,680 | | 3,330 | | 15,046 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Steam..... | | | | | 15 | \$807,315 |
| Tonnage..... | | | | | 1,791 | |
| Outfit..... | | | | | | 246,655 |
| Gasoline..... | 27 | \$119,848 | 23 | \$377,600 | 108 | 918,163 |
| Tonnage..... | 159 | | 725 | | 2,559 | |
| Outfit..... | | 41,416 | | 71,287 | | 281,138 |
| Sail..... | 5 | 2,315 | | | 86 | 52,010 |
| Tonnage..... | 44 | | | | 789 | |
| Outfit..... | | 325 | | | | 14,485 |
| Vessels transporting: | | | | | | |
| Gasoline..... | 1 | 500 | 7 | 32,300 | 40 | 68,400 |
| Tonnage..... | 9 | | 89 | | 369 | |
| Outfit..... | | 125 | | 3,850 | | 19,100 |
| Sail..... | | | | | 12 | 9,700 |
| Tonnage..... | | | | | 92 | |
| Outfit..... | | | | | | 4,450 |
| Boats: | | | | | | |
| Sail, row, etc..... | 313 | 8,805 | 407 | 26,180 | 3,286 | 82,848 |
| Power..... | 99 | 77,400 | 839 | 459,650 | 2,346 | 827,370 |
| Apparatus, vessel fisheries: | | | | | | |
| Purse seines..... | 4 | 4,800 | 25 | 52,900 | 86 | 214,427 |
| Gill nets..... | | | | | 13 | 800 |
| Lines..... | | 105 | | | | 255 |
| Otter trawls..... | 12 | 705 | | | 14 | 805 |
| Dredges..... | 6 | 360 | | | 92 | 2,955 |
| Tongs and grabs..... | 42 | 160 | | | 229 | 787 |
| Apparatus, shore fisheries: | | | | | | |
| Purse seines..... | | | 2 | 3,000 | 5 | 4,600 |
| Haul seines..... | 2 | 80 | 115 | 58,030 | 582 | 102,193 |
| Gill nets..... | 139 | 5,955 | 715 | 101,725 | 15,386 | 233,083 |
| Pound nets..... | | | | | 3,779 | 355,439 |
| Flye nets..... | | | | | 591 | 6,230 |
| Cast nets..... | 1 | 3 | 16 | 80 | 88 | 238 |
| Stop nets..... | | | | | 8 | 220 |
| Lines..... | | 13 | | 2,965 | | 3,826 |
| Otter trawls..... | 73 | 3,700 | 255 | 16,500 | 357 | 21,250 |
| Eel pots..... | | | | | 1,585 | 1,329 |
| Dredges..... | | | | | 550 | 2,648 |
| Tongs, grabs, and rakes..... | 400 | 1,264 | 37 | 224 | 1,994 | 5,016 |
| Spears or gigs..... | | | 12 | 12 | 128 | 117 |
| Crab traps and drags..... | | | 20 | 50 | 133 | 615 |
| Other apparatus..... | | | | 6 | | 406 |
| Store and accessory property..... | | 429,779 | | 858,720 | | 2,731,918 |
| Cash capital..... | | 72,400 | | 151,600 | | 403,150 |
| Total..... | | 769,988 | | 2,210,679 | | 7,425,971 |

FISHERIES OF THE SOUTH ATLANTIC STATES—Continued.

| Item. | Georgia. | | Florida (east coast). | | Total. | |
|-------------------------------|------------|---------|-----------------------|----------|-------------|-----------|
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: | | | 692,265 | \$10,373 | 9,441,709 | \$249,472 |
| Fresh | | | | | 5,743,876 | 162,595 |
| Salted | | | | | 11,686 | 390 |
| Amberfish | | | 11,686 | 390 | 11,890 | 431 |
| Angelfish | | | 2,915 | 91 | 2,915 | 97 |
| Barracuda | | | 2,915 | 97 | 551,125 | 63,137 |
| Black bass | | | | | 892,045 | 85,567 |
| Bluefish | 5,000 | \$900 | 561,301 | \$4,715 | 50,750 | 1,542 |
| Blue runner or hardtail | | | 50,750 | 1,542 | 11,156 | 365 |
| Bonito | | | 8,141 | 258 | 34,372 | 319 |
| Bowfin | | | | | 736,057 | 25,000 |
| Butterfish | | | 4,200 | 170 | 153,169 | 5,619 |
| Carp | | | | | 323,984 | 10,434 |
| Catfish | 2,675 | 265 | 13,900 | 278 | 2,483,647 | 161,562 |
| Cero and Kingfish | 74 | 7 | 2,271,792 | 147,608 | 50 | 2 |
| Cowfish and "shellfish" | | | 50 | 2 | 5,340 | 568 |
| Crappie | | | | | 321,534 | 9,909 |
| Crocodile | | | 321,030 | 9,833 | 532,985 | 16,676 |
| Croaker | 5,900 | 255 | 124,278 | 3,447 | 1,007,311 | 28,281 |
| Drum, red and black | 1,674 | 112 | 900,091 | 24,638 | 174,541 | 13,333 |
| Eels | | | | | 131,611 | 9,470 |
| Flounders | 10,800 | 650 | 13,490 | 737 | 44,525 | 1,154 |
| Gizzard shad | | | | | 102,541 | 4,641 |
| Groupers | 27,758 | 1,019 | 74,783 | 3,622 | 129,291 | 4,811 |
| Grimps | 512 | 26 | 113,679 | 3,629 | 191,950 | 17,423 |
| Hickory shad | 13,007 | 2,035 | | | 250 | 11 |
| Hogfish | | | 250 | 11 | 12,487 | 365 |
| Jewfish | | | 12,487 | 365 | 364,363 | 21,779 |
| King whiting | 27,230 | 1,468 | 297,008 | 15,604 | 1,280 | 13 |
| Ladyfish | | | 1,280 | 13 | 370 | 13 |
| Leatherjacket or "turbot" | | | 370 | 13 | 257,757,799 | 1,605,117 |
| Menhaden | 29,484,600 | \$8,453 | 48,362,600 | 210,175 | 7,970 | 245 |
| Moonfish | | | 7,970 | 245 | | |
| Mullet: | | | | | | |
| Fresh | 10,650 | 693 | 10,417,889 | 397,147 | 11,299,268 | 454,797 |
| Salted | | | | | 458,050 | 53,247 |
| Parrotfish | | | 3,500 | 70 | 3,500 | 70 |
| Perch: | | | | | | |
| White | | | | | 617,088 | 31,150 |
| Yellow | | | | | 223,813 | 10,147 |
| Permit | | | 7,290 | 244 | 7,290 | 244 |
| Pigfish: | | | | | | |
| Fresh | | | 14,762 | 451 | 279,034 | 13,126 |
| Salted | | | | | 3,125 | 63 |
| Pike | | | | | 20,552 | 1,898 |
| Pinfish or sailer's choice | | | 442,535 | 13,033 | 495,014 | 14,406 |
| Pompano | | | 133,419 | 19,880 | 142,104 | 20,883 |
| Porgies | | | 5,950 | 328 | 7,950 | 458 |
| Porkfish | | | 1,710 | 57 | 1,710 | 67 |
| Scup | 12,000 | 900 | | | 12,000 | 900 |
| Sea bass | 292,615 | 23,765 | 41,331 | 2,699 | 577,596 | 50,592 |
| Sea gar or needlefish | | | 100 | 5 | 100 | 5 |
| Sergeantfish or snook | | | 314,774 | 8,629 | 314,774 | 8,629 |
| Shad | 100,540 | 26,960 | 963,606 | 135,844 | 2,888,644 | 568,585 |
| Sharks | 1,289 | 30 | 63,775 | 526 | 85,064 | 731 |
| Sheepshead | 400 | 25 | 104,303 | 4,115 | 133,026 | 6,189 |
| Skates | | | | | 2,000 | 15 |
| Snapper: | | | | | | |
| Mangrove | | | 23,186 | 975 | 23,186 | 975 |
| Mutton | | | 241,078 | 7,399 | 241,078 | 7,399 |
| Red | 112,349 | 7,810 | 20,200 | 2,000 | 132,549 | 9,810 |
| Spanish mackerel | | | 3,061,965 | 218,085 | 3,211,405 | 232,355 |
| Spot: | | | | | | |
| Fresh | 1,100 | 59 | 393,030 | 11,998 | 1,624,400 | 66,942 |
| Salted | | | | | 68,375 | 5,853 |
| Squeteagues or "sea trout": | | | | | | |
| Fresh | 39,550 | 4,097 | 1,645,223 | 142,091 | 5,105,169 | 360,517 |
| Salted | | | | | 80 | 10 |
| Striped bass | 125 | 10 | | | 286,653 | 46,040 |
| Sturgeon | 39,150 | 4,700 | | | 163,291 | 26,810 |
| Sturgeon caviar | | | | | 1,336 | 2,386 |
| Suckers | | | | | 16,464 | 680 |
| Sunfish | | | | | 126,980 | 1,382 |
| Tautog | | | | | 150 | 9 |
| Tidefish | 35,000 | 2,400 | | | 35,000 | 2,400 |
| Yellowtail or "silver perch" | 2,000 | 100 | 43,970 | 1,279 | 78,148 | 2,795 |
| Shrimp | 5,793,465 | 173,990 | 8,867,918 | 266,651 | 15,656,903 | 470,346 |
| Crabs: | | | | | | |
| Hard | 8,455 | 504 | 52,000 | 1,800 | 1224,060 | 4,687 |
| Soft | | | | | 224,005 | 23,896 |
| Sea crawfish or spiny lobster | | | 23,503 | 1,174 | 23,503 | 1,174 |

1 672,180 in number.

2 702,015 in number.

FISHERIES OF THE SOUTH ATLANTIC STATES—Continued.

| Item. | Georgia. | | Florida (east coast). | | Total. | |
|--------------------------|------------|---------|-----------------------|-----------|------------------------|-----------|
| PRODUCTS—continued. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Clams, hard..... | 120 | \$75 | 2,400 | \$600 | ¹ 200,896 | \$47,473 |
| Conch meat..... | | | 7,000 | 700 | 7,000 | 700 |
| Oysters, market: | | | | | | |
| Public..... | 481,530 | 30,884 | 313,425 | 15,134 | ² 4,927,244 | 197,290 |
| Private..... | 628,292 | 43,029 | 145,565 | 4,994 | ³ 944,132 | 63,573 |
| Scallops..... | | | | | ⁴ 422,832 | 31,618 |
| Octopus..... | 2,731 | 268 | | | 2,731 | 268 |
| Terrapin..... | 2,112 | 454 | | | 3,597 | 1,091 |
| Turtles..... | 11,250 | 100 | 6,850 | 402 | 26,500 | 579 |
| Shark hides..... | | | | | 19,125 | 2,868 |
| Other aquatic hides..... | | | | | 1,050 | 157 |
| Total..... | 37,153,953 | 416,043 | 81,211,488 | 1,746,175 | 332,614,123 | 5,348,616 |

¹ 25,112 bushels.² 703,892 bushels.³ 134,876 bushels.⁴ 70,472 bushels.EXTENT OF FISHERIES OF SOUTH ATLANTIC STATES, VARIOUS YEARS, 1880 TO 1918.¹

| State. | 1880 | 1887 | 1888 | 1889 |
|---------------------------|------------|------------------|------------------|------------|
| PERSONS ENGAGED. | | | | |
| North Carolina..... | 5,274 | 7,352 | 7,704 | 8,655 |
| South Carolina..... | 1,005 | 1,280 | 1,346 | 2,642 |
| Georgia..... | 899 | 627 | 638 | 1,497 |
| Florida (east coast)..... | 368 | (²) | 851 | 1,244 |
| Total..... | 7,546 | (²) | 10,539 | 14,038 |
| INVESTMENT. | | | | |
| North Carolina..... | \$506,561 | \$766,881 | \$801,474 | \$968,600 |
| South Carolina..... | 66,275 | 92,930 | 97,189 | 107,205 |
| Georgia..... | 78,770 | 61,806 | 65,556 | 120,975 |
| Florida (east coast)..... | 43,554 | (²) | 109,670 | 128,434 |
| Total..... | 695,160 | (²) | 1,073,889 | 1,325,214 |
| PRODUCTS. | | | | |
| Pounds: | | | | |
| North Carolina..... | 32,249,488 | 45,121,956 | 43,022,855 | 45,545,643 |
| South Carolina..... | 6,143,250 | 4,075,537 | 4,180,847 | 4,879,125 |
| Georgia..... | 2,272,500 | 1,882,790 | 1,957,749 | 2,643,533 |
| Florida (east coast)..... | 2,286,750 | (²) | (²) | 5,982,375 |
| Total..... | 42,951,988 | (²) | (²) | 59,050,676 |
| Value: | | | | |
| North Carolina..... | \$845,695 | \$772,957 | \$776,439 | \$950,427 |
| South Carolina..... | 212,482 | 157,688 | 163,657 | 200,381 |
| Georgia..... | 119,993 | 80,745 | 82,910 | 105,727 |
| Florida (east coast)..... | 78,408 | (²) | 173,886 | 199,043 |
| Total..... | 1,256,578 | (²) | 1,196,892 | 1,455,578 |

¹ Statistics for 1908 are from data published by the Bureau of the Census.² Statistics not available.

EXTENT OF FISHERIES OF SOUTH ATLANTIC STATES, VARIOUS YEARS, 1880 TO 1918—
Continued.

| State. | 1890 | 1897 | 1902 | 1908 | 1918 |
|---------------------------|-------------|-------------|-------------|-------------|-------------|
| PERSONS ENGAGED. | | | | | |
| North Carolina..... | 10,274 | 12,045 | 14,755 | 9,681 | 8,036 |
| South Carolina..... | 2,701 | 2,139 | 3,713 | 2,559 | 2,000 |
| Georgia..... | 1,622 | 1,869 | 2,286 | 2,525 | 1,680 |
| Florida (east coast)..... | 1,404 | 1,132 | 2,698 | 3,196 | 3,330 |
| Total..... | 16,001 | 17,185 | 23,452 | 17,961 | 15,046 |
| INVESTMENT. | | | | | |
| North Carolina..... | \$1,243,988 | \$1,218,459 | \$1,973,441 | \$1,270,000 | \$4,222,043 |
| South Carolina..... | 127,762 | 174,354 | 320,723 | 114,000 | 221,251 |
| Georgia..... | 174,431 | 281,864 | 342,150 | 409,000 | 769,998 |
| Florida (east coast)..... | 142,105 | 151,155 | 354,835 | 531,000 | 2,210,679 |
| Total..... | 1,688,286 | 1,828,832 | 2,991,149 | 2,324,000 | 7,423,971 |
| PRODUCTS. | | | | | |
| Pounds: | | | | | |
| North Carolina..... | 51,799,142 | 64,234,257 | 67,584,734 | 101,422,000 | 210,501,750 |
| South Carolina..... | 4,944,840 | 5,280,446 | 8,174,463 | 14,104,000 | 3,746,932 |
| Georgia..... | 2,994,117 | 4,993,100 | 11,102,610 | 14,828,000 | 37,153,953 |
| Florida (east coast)..... | 7,463,531 | 5,882,662 | 19,584,265 | 36,521,000 | 81,211,488 |
| Total..... | 67,201,630 | 80,390,465 | 106,446,072 | 166,875,000 | 332,614,123 |
| Value: | | | | | |
| North Carolina..... | \$1,027,669 | \$1,316,017 | \$1,739,661 | \$1,776,000 | \$2,978,708 |
| South Carolina..... | 202,602 | 210,456 | 263,023 | 288,000 | 207,690 |
| Georgia..... | 123,563 | 170,605 | 359,081 | 701,000 | 416,043 |
| Florida (east coast)..... | 219,870 | 136,077 | 477,868 | 1,269,000 | 1,746,175 |
| Total..... | 1,573,704 | 1,833,155 | 2,839,633 | 4,034,000 | 5,348,616 |

¹ Exclusive of persons and investment in canneries, packing houses, and other establishments.OYSTER INDUSTRY OF SOUTH ATLANTIC STATES, VARIOUS YEARS, 1880 TO 1918.¹

| Year. | North Carolina. | | South Carolina. | | Georgia. | | Florida (east coast). | | Total. | |
|-----------|-----------------|---------------|-----------------|---------------|-----------------|---------------|-----------------------|---------------|-----------------|---------------|
| | <i>Bushels.</i> | <i>Value.</i> | <i>Bushels.</i> | <i>Value.</i> | <i>Bushels.</i> | <i>Value.</i> | <i>Bushels.</i> | <i>Value.</i> | <i>Bushels.</i> | <i>Value.</i> |
| 1880..... | 170,000 | \$60,000 | 50,000 | \$20,000 | 70,000 | \$35,000 | 20,000 | \$5,000 | 310,000 | \$120,000 |
| 1887..... | 212,980 | 48,353 | 37,725 | 18,581 | 110,085 | 26,950 | (2) | (2) | (2) | (2) |
| 1888..... | 204,703 | 46,129 | 40,242 | 19,146 | 120,600 | 29,370 | 57,750 | 12,950 | 423,295 | 107,595 |
| 1889..... | 1,001,620 | 194,272 | 43,620 | 19,890 | 163,200 | 26,684 | 62,356 | 11,123 | 1,270,796 | 251,969 |
| 1890..... | 807,260 | 175,567 | 63,150 | 23,204 | 224,355 | 40,520 | 97,350 | 14,850 | 1,192,115 | 254,141 |
| 1895..... | (2) | (2) | (2) | (2) | (2) | (2) | 99,434 | 15,415 | (2) | (2) |
| 1897..... | 858,818 | 241,069 | 214,900 | 45,360 | 486,634 | 86,709 | 51,829 | 11,766 | 1,612,181 | 384,934 |
| 1902..... | 1,022,813 | 268,363 | 689,700 | 118,460 | 1,224,000 | 220,467 | 309,069 | 37,188 | 3,245,582 | 644,478 |
| 1908..... | 812,500 | 239,160 | 1,563,000 | 137,000 | 1,459,000 | 338,600 | 529,000 | 108,600 | 4,363,500 | 820,300 |
| 1910..... | 332,257 | 63,405 | 710,124 | 94,677 | 505,157 | 170,812 | 153,460 | 35,290 | 1,700,998 | 364,184 |
| 1918..... | 216,062 | 70,280 | 397,690 | 96,542 | 158,516 | 73,913 | 65,570 | 20,128 | 838,738 | 260,863 |

¹ Statistics for 1908 are from data published by the Bureau of the Census.² Statistics not available.

FISHERIES OF NORTH CAROLINA.

The fisheries of North Carolina were more extensive than those of South Carolina, Georgia, and eastern coast of Florida combined in persons engaged, investment, and quantity and value of the products. In 1918 the number of persons employed in the coastal fisheries of this State was 8,036, of whom 1,295 were on vessels fishing, 54 on transporting vessels, 4,903 in the shore or boat fisheries, and 1,784 on shore in the wholesale establishments, canneries, and other fishery industries.

The investment in the fisheries of \$4,222,043 includes 118 fishing vessels, valued at \$1,249,725, with a net tonnage of 3,437 tons and outfits valued at \$422,790; 37 transporting vessels, valued at \$34,300, with a net tonnage of 289 tons and outfits valued at \$18,225; 3,084 power, sail, row, and other boats valued at \$307,773; fishing apparatus employed on vessels to the value of \$160,432; fishing apparatus employed in shore or boat fisheries to the value of \$522,104; shore and accessory property valued at \$1,347,644; and cash capital amounting to \$159,050.

The products amounted to 210,501,750 pounds, valued at \$2,978,708. The species of chief importance arranged in order of their value were: Menhaden, 179,910,599 pounds, valued at \$1,306,489; alewives, 14,483,820 pounds, valued at \$401,219, of which 5,743,876 pounds, valued at \$162,595, were salted; shad, 1,657,036 pounds, valued at \$376,696; squeteague or "sea trout," 3,361,326 pounds, valued at \$209,493; mullet, 1,128,029 pounds, valued at \$91,075, of which 315,350 pounds, valued at \$38,341, were salted; oysters, 1,518,734 pounds, or 216,962 bushels, valued at \$70,280; black bass, 551,125 pounds, valued at \$63,137; spot, 1,236,095 pounds, valued at \$56,299, of which 42,825 pounds, valued at \$3,768, were salted; hard clams, 197,576 pounds, or 24,697 bushels, valued at \$46,598; and striped bass, 286,528 pounds, valued at \$46,030.

Menhaden represents 85.46 per cent of the total quantity and 43.86 per cent of the total value of the products of the State in 1918. The products of the fisheries exclusive of menhaden for various years follow: 39,388,742 pounds, valued at \$1,011,498, in 1890; 52,924,257 pounds, valued at \$1,296,317, in 1897; 48,722,734 pounds, valued at \$1,708,241, in 1902; 44,010,000 pounds, valued at \$1,706,000, in 1908, and 30,591,151 pounds, valued at \$1,672,219, in 1918. From the foregoing it will be evident that the trend of production of food fishes is downward and should be a matter of some concern to the State. As indicative of the trend of certain of the important fisheries of the State, the following table gives the comparative production figures for various years:

PRODUCTS OF CERTAIN FISHERIES OF NORTH CAROLINA, VARIOUS YEARS, 1890 TO 1918.

| Species. | 1890 | 1897 | 1902 | 1908 | 1918 |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> | <i>Pounds.</i> |
| Alewives..... | 16,481,063 | 15,790,437 | 11,172,975 | 10,928,000 | 14,483,820 |
| Bluefish..... | 1,315,194 | 1,096,175 | 977,142 | 1,256,000 | 322,714 |
| Mullet..... | 3,585,981 | 3,409,585 | 6,705,492 | 5,070,800 | 1,128,029 |
| Shad..... | 5,768,413 | 8,963,488 | 6,566,721 | 3,942,000 | 1,657,036 |
| Squeteagues or "sea trout"..... | 1,885,677 | 3,090,254 | 3,781,456 | 4,635,000 | 3,361,326 |
| Striped bass..... | 508,341 | 845,123 | 1,175,400 | 510,000 | 286,528 |
| | <i>Bushels.</i> | <i>Bushels.</i> | <i>Bushels.</i> | <i>Bushels.</i> | <i>Bushels.</i> |
| Clams..... | 28,269 | 117,226 | 146,897 | 91,000 | 24,697 |
| Oysters..... | 807,260 | 858,818 | 1,022,813 | 812,500 | 216,962 |

An examination of this table reveals a very marked decline in the catch of bluefish, mullet, shad, striped bass, clams, and oysters, while the fisheries for alewives and squeteagues have fluctuated comparatively little. In 1918 the catch of bluefish amounted to only 25.69 per cent of that in 1908; of mullet, to only 22.25 per cent of the 1908 catch; of shad, to only 42.04 per cent of the catch in 1908, and 25.23 per cent of the catch in 1902; of striped bass, to

only 56.18 per cent of the 1908 catch and 24.38 per cent of the 1902 catch; of clams, to only 27.14 per cent of the 1908 catch and 16.81 per cent of the 1902 catch; and of oysters, to only 26.70 per cent of the 1908 catch and 21.21 per cent of the 1902 catch.

The principal factors affecting the abundance of shad in our Atlantic coast waters appear to be unsatisfactory spawning areas, due to pollution and artificial barriers restricting the movements of the fish in the rivers, and interference with the fish in their migrations to the spawning areas and while on these areas. It is conceivable that, unless these conditions are rectified, the consumer may have to depend on the Pacific coast for these fish at some not far distant date. In North Carolina, while pollution is believed to have been a less significant factor than in some of the other States, interference with the free movement of a sufficient body of the fish to the spawning areas and during the spawning period is considered to be an important factor affecting the supply of fish in the waters, which fish-cultural operations have been unable to wholly counteract. A study of the production figures for striped bass would indicate that the supply of this fish is being depleted. Difficulties in propagation, such as inability to procure ripe fish of both sexes at same time, handicap operations in this field. The decline in the catch of oysters would indicate how important it is for the State to give more serious consideration to the encouragement of oyster farming. In this connection the results of former investigations of the Bureau should prove of interest, notably a document by Dr. Caswell Grave.¹⁰

FISHERIES BY COUNTIES.

The statistics as to the number of persons employed, investment, and products of the fisheries of North Carolina in 1918 are given by counties in the appended table. It will be noted that of the catch of sea bass of 111,650 pounds, valued at \$10,928, 59,650 pounds, valued at \$5,763, are credited to Carteret County. The increase in the catch for this county is directly attributable in large part to the Bureau for its work in locating the small fishing grounds along this section of the coast and for encouragement given to the establishment of an important fishery. Difficulties in marketing the catch at satisfactory prices are reported to have retarded the fullest development of this fishery.

As a result of the Bureau's efforts to develop fisheries for sharks and other unutilized aquatic animals and to encourage the saving of the hides for tanning into leather and the extraction of the liver oil of sharks, etc., 20,175 pounds of the hides of sharks, porpoise, etc., valued at \$3,025, and 720 gallons of shark oil, valued at \$540, were saved in 1918.

¹⁰ Grave, Caswell: Investigations for the Promotion of the Oyster Industry of North America. Report U. S. Commission of Fish and Fisheries, 1903 (1905), p. 247-341, X pl.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES.

| Item. | Beaufort. | | Bertie. | | Bladen. | | Brunswick. | |
|---------------------------|-----------|---------|---------|---------|---------|---------|------------|----------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 12 | | | | | | 59 | |
| On vessels transporting.. | 18 | | | | | | | |
| In shore fisheries..... | 236 | | 22 | | 15 | | 301 | |
| Shoresmen..... | 167 | | 13 | | | | 147 | |
| Total..... | 433 | | 35 | | 45 | | 507 | |
| INVESTMENT. | | | | | | | | |
| Vessels fishing: | | | | | | | | |
| Gasoline..... | | | | | | | 5 | \$89,620 |
| Tonnage..... | | | | | | | 160 | |
| Outfit..... | | | | | | | | 17,510 |
| Sail..... | 4 | \$2,750 | | | | | | |
| Tonnage..... | 30 | | | | | | | |
| Outfit..... | | 950 | | | | | | |
| Vessels transporting: | | | | | | | | |
| Gasoline..... | 2 | 7,500 | | | | | | |
| Tonnage..... | 15 | | | | | | | |
| Outfit..... | | 3,000 | | | | | | |
| Sail..... | 7 | 7,000 | | | | | | |
| Tonnage..... | 30 | | | | | | | |
| Outfit..... | | 3,500 | | | | | | |
| Boats: | | | | | | | | |
| Sail, row, etc..... | 74 | 6,195 | 1 | \$5 | 23 | \$270 | 151 | 2,210 |
| Power..... | 25 | 6,400 | 7 | 1,600 | | | 17 | 8,450 |
| Apparatus, vessel fish- | | | | | | | | |
| eries: | | | | | | | | |
| Purse seines..... | | | | | | | 3 | 9,000 |
| Other trawls..... | | | | | | | 2 | 100 |
| Dredges..... | 8 | 160 | | | | | | |
| Apparatus, shore fish- | | | | | | | | |
| eries: | | | | | | | | |
| Haul seines..... | 15 | 6,700 | | | | | 21 | 1,800 |
| Gill nets..... | 490 | 903 | | | 22 | 350 | 100 | 2,475 |
| Pound nets..... | 137 | 10,210 | 73 | 9,585 | | | | |
| Lines..... | | | | | | | | 1 |
| Other trawls..... | | | | | | | 14 | 570 |
| Dredges..... | 24 | 540 | | | | | | |
| Tongs and rakes..... | 2 | 6 | | | | | 160 | 268 |
| Eel pots..... | 250 | 325 | | | | | | |
| Other apparatus..... | | | | | 1 | 12 | 6 | 90 |
| Shore and accessory prop- | | | | | | | | |
| erty..... | | 39,975 | | 1,950 | | | | 65,685 |
| Cash capital..... | | 34,000 | | | | | | 5,800 |
| Total..... | | 132,123 | | 13,140 | | 632 | | 153,579 |
| PRODUCTS. | | | | | | | | |
| Alewives: | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Fresh..... | 325,805 | \$5,700 | 214,845 | \$4,200 | | | | |
| Salted..... | | | 216,039 | 5,905 | | | | |
| Black bass..... | 10,111 | 1,343 | | | | | | |
| Butterfish..... | 70,009 | 4,128 | | | | | | |
| Catfish..... | 44,008 | 1,113 | 982 | 20 | | | | |
| Cero and king fish..... | | | | | | | 3,250 | \$178 |
| Croaker..... | | | | | | | 1,500 | 43 |
| Drum, red and black..... | | | | | | | 1,500 | 73 |
| Eel..... | 39,164 | 1,076 | | | | | | |
| Flounders..... | 5,800 | 348 | | | | | 8,800 | 433 |
| Hickory shad..... | 16,760 | 1,515 | 628 | 31 | | | | |
| Menhaden..... | | | | | | | 9,300,000 | 33,325 |
| Mullet: | | | | | | | | |
| Fresh..... | | | | | | | 28,700 | 2,180 |
| Salted..... | | | | | | | 213,900 | 25,450 |
| Perch: | | | | | | | | |
| White..... | 6,630 | 613 | 2,261 | 121 | | | | |
| Yellow..... | 19,485 | 2,778 | | | | | | |
| Pigfish, fresh..... | | | | | | | 150 | 9 |
| Pike..... | 11,013 | 1,032 | | | | | | |
| Pompano..... | 750 | 60 | | | | | | |
| Sea bass..... | | | | | | | 1,000 | 70 |
| Shad..... | 80,057 | 14,270 | 5,366 | 1,182 | 4,077 | \$1,165 | 2,050 | 425 |
| Sheephead..... | | | | | | | 1,800 | 106 |
| Spot: | | | | | | | | |
| Fresh..... | 5,148 | 255 | | | | | 11,250 | 587 |
| Salted..... | | | | | | | 36,700 | 3,370 |
| Squeakers, or "sea | | | | | | | | |
| trout," fresh..... | 314,892 | 10,734 | | | | | 8,600 | 604 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

| Item. | Beaufort. | | Bertie. | | Bladen. | | Brunswick. | |
|---------------------------|-----------|---------|---------|--------|---------|---------|------------|--------|
| PRODUCTS—continued. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| Striped bass..... | 24,701 | \$3,426 | 333 | \$50 | | | 1,000 | \$100 |
| Suckers..... | 4,890 | 124 | 131 | 8 | | | | |
| Tautog..... | | | | | | | 150 | 9 |
| Shrimp..... | | | | | | | 370,000 | 11,100 |
| Crabs: | | | | | | | | |
| Hard..... | | | | | | | 650 | 20 |
| Soft..... | | | | | | | 40 | 10 |
| Turtles..... | | | | | | | 500 | 13 |
| Clams, hard..... | | | | | | | 44,000 | 8,350 |
| Oysters, market, public.. | 65,415 | 4,535 | | | | | 4,725 | 500 |
| Total..... | 1,066,698 | 54,140 | 437,585 | 11,527 | 4,077 | \$1,165 | 10,040,265 | 86,955 |

| Item. | Camden. | | Carteret. | | Chowan. | | Columbus. | |
|-----------------------------------|---------|--------|-----------|-----------|-----------|----------|-----------|--------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | | | 656 | | | | | |
| On vessels transporting..... | | | 35 | | | | | |
| In shore fisheries..... | 8 | | 1,251 | | 285 | | 30 | |
| Shoresmen..... | | | 766 | | 167 | | | |
| Total..... | 8 | | 2,708 | | 452 | | 30 | |
| INVESTMENT. | | | | | | | | |
| Vessels fishing: | | | | | | | | |
| Gasoline..... | | | 49 | \$356,150 | | | | |
| Tonnage..... | | | 1,026 | | | | | |
| Outfit..... | | | | 142,350 | | | | |
| Sail..... | | | 26 | 17,500 | | | | |
| Tonnage..... | | | 232 | | | | | |
| Outfit..... | | | | 5,145 | | | | |
| Vessels transporting: | | | | | | | | |
| Gasoline..... | | | 22 | 16,600 | | | | |
| Tonnage..... | | | 177 | | | | | |
| Outfit..... | | | | 8,025 | | | | |
| Sail..... | | | 4 | 2,450 | | | | |
| Tonnage..... | | | 36 | | | | | |
| Outfit..... | | | | 925 | | | | |
| Boats: | | | | | | | | |
| Sail, row, etc..... | 3 | \$45 | 414 | 9,755 | 29 | \$1,100 | 15 | \$160 |
| Power..... | 5 | 835 | 461 | 112,875 | 101 | 26,410 | | |
| Apparatus, vessel fisheries: | | | | | | | | |
| Purse seines..... | | | 38 | 102,600 | | | | |
| Gill nets..... | | | 13 | 800 | | | | |
| Lines..... | | | | 50 | | | | |
| Dredges..... | | | 42 | 1,530 | | | | |
| Tongs..... | | | 16 | 82 | | | | |
| Apparatus, shore fisheries: | | | | | | | | |
| Haul seines..... | | | 123 | 3,185 | | | | |
| Purse seines..... | | | 1 | 1,000 | | | | |
| Gill nets..... | 82 | 972 | 1,877 | 49,305 | 234 | 6,288 | 15 | 150 |
| Pound nets..... | | | 268 | 24,750 | 967 | 103,936 | | |
| Fyke nets..... | 40 | 400 | | | | | | |
| Lines..... | | | | 230 | | | | |
| Otter trawls..... | | | 13 | 390 | | | | |
| Dredges..... | | | 492 | 1,525 | | | | |
| Tongs and rakes..... | | | 182 | 432 | | | | |
| Eel pots..... | | | 25 | 35 | | | | |
| Other apparatus..... | | | 370 | 659 | | | | |
| Shore and accessory property..... | | | | 543,480 | | 63,405 | | |
| Cash capital..... | | | | 74,000 | | | | |
| Total..... | | 2,252 | | 1,475,828 | | 201,089 | | 310 |
| PRODUCTS. | | | | | | | | |
| Alwolves: | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Fresh..... | | | 75,636 | \$3,774 | 4,747,518 | \$98,415 | | |
| Salted..... | | | | | 3,230,025 | 87,768 | | |
| Angel fish..... | | | 3,800 | 155 | | | | |
| Bluefish..... | | | 261,055 | 23,545 | | | | |
| Bonito..... | | | 3,015 | 107 | | | | |
| Butterfish..... | | | 71,999 | 4,379 | | | | |
| Catfish..... | 2,400 | \$120 | | | 62,727 | 2,218 | | |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

| Item. | Camden. | | Carteret. | | Chowan. | | Columbus. | |
|---|---------|--------|------------|----------|-----------|---------|-----------|--------|
| PRODUCTS—continued. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Cero and king fish..... | | | 151,871 | \$10,615 | | | | |
| Crevalle..... | | | 204 | 11 | | | | |
| Croaker..... | | | 323,226 | 9,863 | | | | |
| Drum, red and black..... | | | 32,165 | 1,332 | | | | |
| Eels..... | | | 1,500 | 150 | 6,860 | \$549 | | |
| Flounders..... | | | 8,173 | 543 | | | | |
| Gizzard shad..... | | | | | 34,629 | 1,036 | | |
| Hickory shad..... | | | 23,611 | 1,449 | 58,283 | 5,832 | | |
| Menhaden..... | | | 90,232,799 | 480,212 | | | | |
| Mullet: | | | | | | | | |
| Fresh..... | | | 405,855 | 19,804 | | | | |
| Salted..... | | | 22,500 | 4,000 | | | | |
| Perch, white..... | 2,300 | \$230 | | | 72,890 | 6,333 | | |
| Pigfish, fresh..... | | | 152,669 | 4,859 | | | | |
| Pike..... | | | | | 294 | 28 | | |
| Pinfish, or sailor's choice..... | | | 18,380 | 238 | | | | |
| Pompano..... | | | 2,768 | 332 | | | | |
| Sea bass..... | | | 59,650 | 5,763 | | | | |
| Shad..... | 17,800 | 4,450 | 53,994 | 13,753 | 173,472 | 34,736 | 1,575 | \$450 |
| Sheepshead..... | | | 17,039 | 988 | | | | |
| Spanish mackerel..... | | | 115,330 | 11,372 | | | | |
| Spot, fresh..... | | | 792,565 | 30,603 | | | | |
| Squeteagues, or "sea trout," fresh..... | | | 1,584,096 | 122,323 | | | | |
| Striped bass..... | | | 995 | 133 | 17,878 | 3,577 | | |
| Sturgeon..... | | | 510 | 27 | | | | |
| Suckers..... | | | | | 8,693 | 383 | | |
| Yellowtail..... | | | 8,108 | 229 | | | | |
| Shrimp..... | | | 450,120 | 9,385 | | | | |
| Crabs: | | | | | | | | |
| Hard..... | | | 2,000 | 150 | | | | |
| Soft..... | | | 233,665 | 23,811 | | | | |
| Terrapin..... | | | 50 | 57 | | | | |
| Turtles..... | | | 7,590 | 44 | | | | |
| Clams, hard..... | | | 47,176 | 8,103 | | | | |
| Oysters, market, public..... | | | \$79,977 | 31,925 | | | | |
| Scallops..... | | | 415,572 | 30,768 | | | | |
| Shark hides..... | | | 19,125 | 2,888 | | | | |
| Other aquatic hides..... | | | 1,050 | 157 | | | | |
| Total..... | 22,500 | 4,800 | 96,479,790 | 857,827 | 8,413,269 | 240,875 | 1,575 | 450 |

| Item. | Craven. | | Currituck. | | Dare. | | Gates. | |
|-----------------------------------|---------|--------|------------|--------|---------|---------|---------|--------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | | | | | 7 | | | |
| In shore fisheries..... | 66 | | 427 | | 762 | | 30 | |
| Shoresmen..... | 4 | | 20 | | 13 | | | |
| Total..... | 70 | | 447 | | 782 | | 30 | |
| INVESTMENT. | | | | | | | | |
| Vessels fishing: | | | | | | | | |
| Sail..... | | | | | 3 | \$1,300 | | |
| Tonnage..... | | | | | 20 | | | |
| Outfit..... | | | | | | 150 | | |
| Boats: | | | | | | | | |
| Sail, row, etc..... | 47 | \$585 | 57 | \$700 | 86 | 3,430 | 22 | \$265 |
| Power..... | 20 | 3,075 | 167 | 15,530 | 287 | 41,600 | 4 | 250 |
| Apparatus, vessel fisheries: | | | | | | | | |
| Dredges..... | | | | | 6 | 30 | | |
| Tongs..... | | | | | 6 | 18 | | |
| Apparatus, shore fisheries: | | | | | | | | |
| Haul seines..... | 8 | 850 | 183 | 16,353 | 34 | 4,525 | | |
| Purse seines..... | | | | | 2 | 600 | | |
| Gill nets..... | 463 | 1,705 | 296 | 1,879 | 7,814 | 16,131 | 74 | 248 |
| Pound nets..... | 25 | 750 | 56 | 10,035 | 1,581 | 143,891 | 10 | 390 |
| Fyke nets..... | | | 465 | 4,550 | | | 15 | 125 |
| Lines..... | | | | | | 30 | | |
| Tongs and rakes..... | | | | | 49 | 188 | | |
| Fad poles..... | 29 | 25 | 1,240 | 879 | | | | |
| Tools and accessory property..... | | 6,263 | | 4,040 | | 31,488 | | |
| Cash capital..... | | | | 2,750 | | 2,000 | | |
| Total..... | | 13,235 | | 56,716 | | 245,681 | | 1,278 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

| Item. | Craven. | | Currituck. | | Dare. | | Gates. | |
|------------------------------|---------|--------|------------|---------|-----------|----------|---------|---------|
| PRODUCTS. | | | | | | | | |
| Alewives: | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Fresh | 22,800 | \$725 | 142,668 | \$4,252 | 777,636 | \$36,700 | 73,688 | \$1,179 |
| Salted | | | 133,083 | 2,140 | 123,355 | 4,547 | | |
| Angel fish | 50 | 2 | | | | | | |
| Black bass | | | 504,164 | 57,372 | 36,850 | 4,422 | | |
| Bluefish | 700 | 42 | | | 46,944 | 4,674 | | |
| Bowfin | | | 34,372 | 319 | | | | |
| Butterfish | 30,000 | 1,200 | | | 437,473 | 12,345 | | |
| Carp | | | 150,741 | 5,449 | | | | |
| Catfish | 1,200 | 24 | 116,012 | 2,379 | 33,981 | 1,645 | 312 | 25 |
| Cero and king fish | | | 10,960 | 548 | 17,815 | 720 | | |
| Crappie | | | | | | | 340 | 68 |
| Croaker | 3,050 | 77 | 13,600 | 354 | 16,538 | 726 | | |
| Drum, red and black | | | | | 35,566 | 795 | | |
| Eels | 500 | 40 | 112,581 | 10,268 | 8,000 | 680 | | |
| Flounders | 600 | 35 | 4,948 | 330 | 19,567 | 977 | | |
| Gizzard shad | | | 9,371 | 97 | | | | |
| Hickory shad | 16,940 | 990 | | | 7,467 | 684 | | |
| Hullet, fresh | 17,400 | 1,395 | | | | | | |
| Perch: | | | | | | | | |
| White | 3,100 | 282 | 412,040 | 16,296 | 71,659 | 2,874 | | |
| Yellow | | | 156,555 | 6,187 | 23,886 | 958 | 312 | 25 |
| Pigfish: | | | | | | | | |
| Fresh | 200 | 5 | | | 37,428 | 1,661 | | |
| Salted | | | | | 3,125 | 63 | | |
| Pike | | | 9,245 | 838 | | | | |
| Pinfish, or sailer's choice | 3,000 | 50 | | | 22,799 | 337 | | |
| Pompano | 75 | 8 | | | 1,012 | 57 | | |
| Shad | 14,013 | 3,633 | 51,096 | 9,359 | 881,270 | 219,272 | 600 | 120 |
| Sheepshead | | | | | 834 | 60 | | |
| Spanish mackerel | 250 | 200 | | | 27,973 | 2,091 | | |
| Spot: | | | | | | | | |
| Fresh | 19,300 | 989 | | | 49,082 | 2,232 | | |
| Salted | | | | | 3,125 | 63 | | |
| Squeteagues, or "sea trout," | | | | | | | | |
| fresh | 36,910 | 2,043 | 25,400 | 1,854 | 901,238 | 47,700 | | |
| Striped bass | 6,375 | 565 | 51,367 | 7,149 | 148,740 | 23,136 | | |
| Sturgeon | | | | | 2,576 | 527 | | |
| Sturgeon caviar | | | | | 661 | 1,487 | | |
| Sunfish | | | 123,980 | 1,202 | | | | |
| Crabs, hard | | | | | 142,290 | 1,778 | | |
| Clams, hard | | | | | 6,400 | 1,200 | | |
| Oysters, market, public | | | | | 60,900 | 4,350 | | |
| Total | 176,463 | 12,305 | 2,062,183 | 126,373 | 3,951,490 | 378,761 | 75,252 | 1,417 |

| Item. | Halifax. | | Hertford. | | Hyde. | | Martin. | |
|------------------------------|----------|--------|-----------|--------|---------|--------|---------|--------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing | | | | | 2 | | | |
| In shore fisheries | 39 | | 29 | | 145 | | 18 | |
| Shoresmen | | | 2 | | | | | |
| Total | 39 | | 31 | | 147 | | 18 | |
| INVESTMENT. | | | | | | | | |
| Vessels fishing: | | | | | | | | |
| Sail | | | | | 1 | \$400 | | |
| Tonnage | | | | | 7 | | | |
| Outfit | | | | | | 150 | | |
| Boats: | | | | | | | | |
| Sail, row, etc. | 4 | \$50 | 11 | \$114 | 26 | 1,245 | 3 | \$75 |
| Power | 19 | 1,170 | 4 | 975 | 55 | 11,295 | | |
| Apparatus, vessel fisheries, | | | | | | | | |
| dredges | | | | | 2 | 60 | | |
| Apparatus, shore fisheries: | | | | | | | | |
| Haul seines | | | 1 | 200 | 1 | 75 | 3 | 500 |
| Gill nets | | | 50 | 253 | 1,684 | 3,028 | | |
| Pound nets | | | 37 | 2,450 | 233 | 22,425 | | |
| Dredges | | | | | 2 | 40 | | |
| Tongs and rakes | | | | | 78 | 310 | | |
| Other apparatus | 47 | 275 | | | | | | |
| Shore and accessory property | | | | 125 | | 1,665 | | |
| Total | | 1,495 | | 4,117 | | 40,693 | | 575 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

| Item. | Halifax. | | Hertford. | | Hyde. | | Martin. | |
|------------------------------------|----------|---------|-----------|---------|---------|---------|---------|---------|
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: | | | | | | | | |
| Fresh | | | 216,875 | \$5,205 | 87,706 | \$3,054 | 30,000 | \$1,500 |
| Salted | | | | | | | 25,000 | 1,200 |
| Angel fish | | | | | 5,125 | 183 | | |
| Bluefish | | | | | 7,495 | 848 | | |
| Butterfish | | | | | 39,626 | 978 | | |
| Catfish | | | | | 2,560 | 64 | 630 | 38 |
| Cero and kingfish | | | | | 3,335 | 119 | | |
| Croaker | | | | | 1,993 | 43 | | |
| Drum, red and black | | | | | 1,350 | 14 | | |
| Eels | | | | | 233 | 10 | | |
| Flounders | | | | | 10,781 | 394 | | |
| Hickory shad | | | | | 15,112 | 700 | | |
| Mullet, salted | | | | | 650 | 160 | | |
| Perch: | | | | | | | | |
| White | | | 1,584 | 96 | 3,078 | 277 | 1,000 | 80 |
| Yellow | | | | | 700 | 49 | | |
| Pigfish, fresh | | | | | 3,125 | 95 | | |
| Pompano | | | | | 1,280 | 92 | | |
| Shad | | | 250 | 50 | 109,827 | 18,396 | | |
| Spanish mackerel | | | | | 2,987 | 242 | | |
| Spot, fresh | | | | | 3,325 | 150 | | |
| Squeteagues, or "sea trout," fresh | | | | | 149,964 | 4,987 | | |
| Striped bass | 6,635 | \$2,770 | | | 10,829 | 1,509 | | |
| Oysters, market, public | | | | | 38,500 | 2,200 | | |
| Total | 6,635 | 2,770 | 218,709 | 5,351 | 499,681 | 34,603 | 56,630 | 2,818 |

| Item. | New Hanover. | | Onslow. | | Pamlico. | | Pasquotank and Perquimans. | |
|------------------------------|--------------|-----------|---------|--------|----------|---------|----------------------------|--------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing | 514 | | | | 46 | | | |
| On vessels transporting | | | | | 1 | | | |
| In shore fisheries | 238 | | 318 | | 97 | | 47 | |
| Shoresmen | 322 | | 35 | | 64 | | 11 | |
| Total | 1,073 | | 353 | | 208 | | 58 | |
| INVESTMENT. | | | | | | | | |
| Vessels fishing: | | | | | | | | |
| Steam | 15 | \$807,315 | | | | | | |
| Tonnage | 1,701 | | | | | | | |
| Outfit | | 246,685 | | | | | | |
| Gasoline | 1 | 17,940 | | | | | | |
| Tonnage | 72 | | | | | | | |
| Outfit | | 6,500 | | | | | | |
| Sail | | | | | 14 | \$6,750 | | |
| Tonnage | | | | | 99 | | | |
| Outfit | | | | | | 3,050 | | |
| Vessels transporting: | | | | | | | | |
| Gasoline | | | | | 1 | 500 | | |
| Tonnage | | | | | 5 | | | |
| Outfit | | | | | | 750 | | |
| Sail | | | | | 1 | \$250 | | |
| Tonnage | | | 6 | | | | | |
| Outfit | | | | 25 | | | | |
| Boats: | | | | | | | | |
| Sail, row, etc. | 157 | 2,600 | 208 | 4,905 | 55 | 1,605 | 13 | \$235 |
| Power | 15 | 3,900 | 40 | 13,775 | 39 | 7,200 | 15 | 3,220 |
| Apparatus, vessel fisheries: | | | | | | | | |
| Purcellines | 16 | 45,127 | | | | | | |
| Dredges | | | | | 28 | 875 | | |
| Apparatus, shore fisheries: | | | | | | | | |
| Haul seines | 22 | 1,180 | 18 | 1,780 | | | | |
| Gill seines | 77 | 3,945 | 411 | 9,850 | 35 | 1,100 | 296 | 4,060 |
| Pound nets | | | | | 70 | 3,375 | 81 | 3,610 |
| Fyke nets | | | | | | | 3 | 20 |
| Lines | | 50 | | 2 | | | | |
| Dredges | | | 14 | 84 | 18 | 450 | | |
| Tongs and rakes | 175 | 100 | 117 | 411 | 35 | 295 | | |
| Eel pots | | | 50 | 65 | | | | |
| Other apparatus | 25 | 23 | 14 | 14 | | | | |
| Shore and accessory property | | 560,336 | | 6,505 | | 6,410 | | 13,000 |
| Cash capital | | 25,000 | | 2,000 | | 2,500 | | 11,000 |
| Total | | 1,719,801 | | 39,696 | | 34,830 | | 35,145 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

| Item. | New Hanover. | | Onslow. | | Pamlico. | | Pasquotank and Perquimans. | |
|------------------------------|--------------|----------|---------|---------|----------|--------|----------------------------|---------|
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alowives: | 15,000 | \$1,200 | 177,507 | \$6,250 | 3,750 | \$125 | 150,000 | \$3,000 |
| Fresh | | | | | | | 39,000 | 390 |
| Salted | | | | | | | | |
| Bluefish | 500 | 62 | 5,400 | 455 | | | | |
| Butterfish | | | 1,000 | 100 | 81,150 | 1,655 | | |
| Catfish | 18,000 | 990 | | | | | | |
| Cero and king fish | 2,000 | 249 | 22,250 | 1,495 | | | | |
| Crappie | | | | | | | 300 | 30 |
| Croaker | | | 13,350 | 352 | 6,250 | 150 | | |
| Drum, red and black | 8,000 | 480 | 3,000 | 22 | 11,665 | 110 | | |
| Eels | | | 3,293 | 329 | | | | |
| Flounders | 10,300 | 1,545 | 4,300 | 335 | | | | |
| Grunts | 15,000 | 1,150 | | | | | | |
| Hickory shad | 5,000 | 400 | | | | | | |
| Menhaden | 80,377,800 | 792,952 | | | | | | |
| Mullet: | | | | | | | | |
| Fresh | | | 193,024 | 14,955 | 4,000 | 400 | | |
| Salted | 32,000 | 2,750 | 47,000 | 5,232 | 5,800 | 800 | | |
| Perch, yellow | | | | | | | 1,875 | 150 |
| Pigfish, fresh | 48,000 | 4,800 | 12,000 | 425 | | | | |
| Pinfish, or sailor's choice | 6,000 | 600 | | | | | | |
| Pompano | 2,300 | 245 | 500 | 100 | | | | |
| Sea bass | 50,000 | 5,000 | 200 | 25 | | | | |
| Shad | 38,660 | 11,275 | | | 20,250 | 3,750 | 134,600 | 26,920 |
| Sheepshead | 5,000 | 600 | 700 | 35 | 850 | 50 | | |
| Spanish mackerel | 1,500 | 225 | 300 | 30 | 1,100 | 110 | | |
| Spot, fresh | 31,000 | 2,350 | 77,050 | 3,865 | 1,250 | 50 | | |
| Squeteagues, or "sea trout": | | | | | | | | |
| Fresh | 13,500 | 1,765 | 103,896 | 9,258 | 198,950 | 5,445 | | |
| Salted | | | | | 80 | 10 | | |
| Striped bass | | | | | | | 9,250 | 1,870 |
| Sturgeon | 3,500 | 420 | | | | | | |
| Sturgeon caviar | 10 | 10 | | | | | | |
| Yellowtail | 3,000 | 180 | | | 170 | 5 | | |
| Shrimp | 120,000 | 3,000 | | | | | | |
| Crabs, hard | 665 | 35 | | | | | | |
| Terrapin | | | 150 | 35 | | | | |
| Turtles | 400 | 20 | | | | | | |
| Clams, hard | 48,000 | 14,500 | 16,800 | 4,645 | | | | |
| Oysters, market: | | | | | | | | |
| Public | 10,500 | 600 | 24,150 | 3,750 | 402,367 | 18,490 | | |
| Private | | | 14,700 | 2,500 | 3,500 | 400 | | |
| Scallops | | | 7,260 | 850 | | | | |
| Total | 80,865,575 | \$47,503 | 727,830 | 55,043 | 741,132 | 31,550 | 335,025 | 32,340 |

| Item. | Pender. | | Tyrrell. | | Washington. | | Total. | |
|-------------------------|---------|--------|----------|--------|-------------|--------|---------|-----------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing | | | | | | | 1,295 | |
| On vessels transporting | | | | | | | 54 | |
| In shore fisheries | 264 | | 89 | | 156 | | 4,903 | |
| Shoreshmen | | | 26 | | 27 | | 1,784 | |
| Total | 264 | | 115 | | 183 | | 8,036 | |
| INVESTMENT. | | | | | | | | |
| Vessels fishing: | | | | | | | | |
| Steam | | | | | | | 15 | \$807,315 |
| Tonnage | | | | | | | 1,791 | |
| Outfit | | | | | | | | 246,685 |
| Gasoline | | | | | | | 55 | 413,710 |
| Tonnage | | | | | | | 1,258 | |
| Outfit | | | | | | | | 166,360 |
| Sail | | | | | | | 48 | 28,700 |
| Tonnage | | | | | | | 388 | |
| Outfit | | | | | | | | 9,745 |
| Vessels transporting: | | | | | | | | |
| Gasoline | | | | | | | 25 | 24,600 |
| Tonnage | | | | | | | 197 | |
| Outfit | | | | | | | | 13,775 |
| Sail | | | | | | | 12 | 9,700 |
| Tonnage | | | | | | | 92 | |
| Outfit | | | | | | | | 4,450 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

| Item. | Pender. | | Tyrrell. | | Washington. | | Total. | |
|----------------------|---------|--------|-----------|----------|-------------|-----------|-------------|-----------|
| | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| PRODUCTS—continued. | | | | | | | | |
| Tautog. | | | | | | | 150 | \$9 |
| Yellowtail. | 20,000 | \$965 | | | | | 31,278 | 1,379 |
| Shrimp. | | | | | | | 940,120 | 23,485 |
| Crabs: | | | | | | | | |
| Hard. | | | | | | | 1 145,605 | 1,983 |
| Soft. | | | | | | | 2 233,705 | 23,821 |
| Terrapin. | | | | | | | 210 | 92 |
| Turtles. | | | | | | | 8,400 | 77 |
| Clams, hard. | 35,200 | 9,800 | | | | | 3 197,576 | 46,598 |
| Oysters, market: | | | | | | | | |
| Public. | 14,000 | 1,000 | | | | | 4 1,500,534 | 67,380 |
| Private. | | | | | | | 5 18,200 | 2,900 |
| Scallops. | | | | | | | 6 422,832 | 31,618 |
| Shark hides. | | | | | | | 19,125 | 2,868 |
| Other aquatic hides. | | | | | | | 1,050 | 157 |
| Total. | 501,750 | 44,284 | 1,937,404 | \$40,554 | 1,880,232 | \$105,297 | 210,501,750 | 2,978,708 |

¹ 436,815 in number.² 701,115 in number.³ 24,697 bushels.⁴ 214,362 bushels.⁵ 2,600 bushels.⁶ 70,472 bushels.

FISHERIES BY APPARATUS.

In the vessel fisheries of North Carolina, in which seven counties are represented, the forms of apparatus in use included purse seines, gill nets, lines, otter trawls, oyster dredges, and oyster tongs. The total yield from all forms of apparatus used on vessels was 179,072,191 pounds, valued at \$1,355,684. The catch with purse seines amounted to 178,101,814 pounds, valued at \$1,305,057, of which 177,868,599 pounds, valued at \$1,297,582, were menhaden. Other of the more important species taken in purse seines included mullet, 71,165 pounds, valued at \$2,630; croakers, 57,000 pounds, valued at \$1,765; and spots, 69,300 pounds, valued at \$1,385. Gill-net fishing yielded 83,300 pounds of fish, chiefly squeteague, croaker, kingfish, and bluefish, valued at \$6,265, and was prosecuted only from vessels operating in Carteret County. The catch of sea bass with lines was 47,500 pounds, valued at \$4,725. Shrimp were taken with otter trawls to the amount of 10,000 pounds, valued at \$300; oysters with dredges, 725,218 pounds, or 103,603 bushels, valued at \$34,912; and oysters with tongs, 104,359 pounds, or 14,908 bushels, valued at \$4,425.

In the shore or boat fisheries pound nets were the most productive form of apparatus, the catch amounting to 16,233,529 pounds, valued at \$683,292. The catch of alewives in pound nets amounted to 12,254,728 pounds, valued at \$301,577, or 75 per cent in quantity and 44 per cent in value of the total take by this form of gear. Other species of importance were squeteagues, shad, and butterfish. The catch with seines in the shore fisheries amounted to 6,028,340 pounds, valued at \$340,795, of which 5,605,300 pounds, valued at \$332,938, were taken in haul seines, the remainder being credited to purse seines. Among the more important species taken in haul seines were alewives, 1,589,037 pounds, valued at \$66,825; black bass, 533,364 pounds, valued at \$60,977; and mullet, 667,065 pounds, valued at \$53,559. The yield by gill nets, which was slightly less in quantity and exceeded in value that of seines, amounted to 5,995,917

pounds, valued at \$386,224. The principal varieties in the order of their value were shad, squeteague, mullet, and spot. The take with tongs, rakes, and hands totaled 767,262 pounds, valued at \$72,455, and with the exception of an incidental catch of scallops and terrapin was made up of oysters and clams. Various species were taken with scoop, dip, and bow nets, amounting to 364,383 pounds, valued at \$34,046; with lines, amounting to 386,010 pounds, valued at \$23,258; with fyke nets, amounting to 283,629 pounds, valued at \$11,375; and by stop nets, amounting to 10,840 pounds, valued at \$605. The catch with otter trawls, confined almost entirely to shrimp, was 592,580 pounds, valued at \$15,149; of scallops and oysters with dredges, 542,363 pounds, valued at \$36,761; of eels with pots, 161,046 pounds, valued at \$12,309; of soft crabs with drags, 38,660 pounds, valued at \$3,725, and of flounders with gigs, 25,000 pounds, valued at \$3,030. The total yield from all forms of apparatus used in the shore or boat fisheries was 31,429,559 pounds, valued at \$1,623,024. The products of the vessel and shore fisheries are shown separately by counties in the appended tables.

YIELD OF VESSEL FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES.

| Apparatus and species. | Beaufort. | | Brunswick. | | Carteret. | | Dare. | |
|---------------------------------------|-----------|---------|------------|----------|------------|---------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Purse seines: | | | | | | | | |
| Bluefish..... | | | | | 4,100 | \$240 | | |
| Butterfish..... | | | | | 1,750 | 70 | | |
| Croaker..... | | | | | 57,000 | 1,765 | | |
| Drum..... | | | | | 650 | 25 | | |
| Kingfish..... | | | | | 250 | 10 | | |
| Menhaden..... | | | 9,300,000 | \$33,325 | 88,190,799 | 471,305 | | |
| Mullet..... | | | | | 71,165 | 2,630 | | |
| Spanish mackerel..... | | | | | 500 | 50 | | |
| Spots..... | | | | | 69,300 | 1,385 | | |
| Squeteague..... | | | | | 28,500 | 1,300 | | |
| Total..... | | | 9,300,000 | 33,325 | 88,421,014 | 478,780 | | |
| Gill nets: | | | | | | | | |
| Bluefish..... | | | | | 4,800 | 415 | | |
| Butterfish..... | | | | | 1,200 | 60 | | |
| Croaker..... | | | | | 13,000 | 420 | | |
| Kingfish..... | | | | | 8,700 | 502 | | |
| Pinfish..... | | | | | 2,600 | 83 | | |
| Spots..... | | | | | 1,000 | 30 | | |
| Squeteague..... | | | | | 52,000 | 4,755 | | |
| Total..... | | | | | 83,500 | 6,265 | | |
| Line: Sea bass..... | | | | | 47,500 | 4,725 | | |
| Otter trawls: Shrimp..... | | | 10,000 | 300 | | | | |
| Dredges: Oysters, market, public..... | 43,610 | \$3,300 | | | 420,175 | 18,702 | 10,000 | \$750 |
| Tongs: Oysters, market, public..... | | | | | 93,359 | 3,675 | 11,000 | 750 |
| Grand total..... | 43,610 | 3,300 | 9,310,000 | 33,625 | 89,068,348 | 512,147 | 21,000 | 1,500 |

YIELD OF VESSEL FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Hyde. | | New Hanover. | | Pamlico. | | Total. | |
|-----------------------------------|---------|--------|--------------|-----------|----------|----------|-------------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Purse seines: | | | | | | | | |
| Bluefish..... | | | | | | | 4,100 | \$240 |
| Butterfish..... | | | | | | | 1,750 | 70 |
| Croaker..... | | | | | | | 57,000 | 1,765 |
| Drum..... | | | | | | | 650 | 25 |
| Kingfish..... | | | | | | | 250 | 10 |
| Menhaden..... | | | 80,377,800 | \$792,952 | | | 177,868,599 | 1,297,582 |
| Mullet..... | | | | | | | 71,165 | 2,630 |
| Spanish mackerel.. | | | | | | | 500 | 50 |
| Spots..... | | | | | | | 69,300 | 1,385 |
| Squeteague..... | | | | | | | 28,500 | 1,300 |
| Total..... | | | 80,377,800 | 792,952 | | | 178,101,814 | 1,305,057 |
| Gill nets: | | | | | | | | |
| Bluefish..... | | | | | | | 4,800 | 415 |
| Butterfish..... | | | | | | | 1,200 | 60 |
| Croaker..... | | | | | | | 13,000 | 420 |
| Kingfish..... | | | | | | | 8,700 | 502 |
| Pigfish..... | | | | | | | 2,600 | 83 |
| Spots..... | | | | | | | 1,000 | 30 |
| Squeteague..... | | | | | | | 52,000 | 4,755 |
| Total..... | | | | | | | 83,300 | 6,265 |
| Lines: Sea bass..... | | | | | | | 47,500 | 4,725 |
| Otter trawls: Shrimp.. | | | | | | | 10,000 | 300 |
| Dredges: Oysters, market, public. | 7,000 | \$500 | | | 244,433 | \$11,660 | 725,218 | 34,912 |
| Tongs: Oysters, market, public. | | | | | | | 104,359 | 4,425 |
| Grand total..... | 7,000 | 500 | 80,377,800 | 792,952 | 244,433 | 11,660 | 179,072,191 | 1,355,684 |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES.

| Apparatus and species. | Beaufort. | | Brunswick. | | Carteret. | | Currituck. | | Craven. | |
|------------------------|-----------|---------|------------|---------|-----------|---------|------------|---------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Purse seines: | | | | | | | | | | |
| Menhaden..... | | | | | 300,000 | \$1,500 | | | | |
| Shrimp..... | | | | | 105,040 | 1,857 | | | | |
| Total..... | | | | | 405,040 | 3,357 | | | | |
| Haul seines: | | | | | | | | | | |
| Alewives— | | | | | | | | | | |
| Fresh..... | 137,365 | \$2,970 | | | | | 86,653 | \$1,835 | 22,600 | \$715 |
| Salted..... | | | | | | | 121,000 | 1,694 | | |
| Black bass..... | 10,111 | 1,343 | | | | | 490,089 | 55,654 | | |
| Bluefish..... | | | | | 7,400 | \$632 | | | 700 | 42 |
| Bowfin..... | | | | | | | 25,979 | 242 | | |
| Butterfish..... | | | | | 2,850 | 117 | | | | |
| Carp..... | | | | | | | 123,472 | 4,631 | | |
| Catfish..... | 37,608 | 953 | | | | | 72,661 | 1,476 | | |
| Croaker..... | | | | | 36,325 | 1,093 | 13,600 | 354 | 2,700 | 60 |
| Drum..... | | | | | 19,265 | 950 | | | | |
| Eels..... | 1,512 | 45 | | | | | | | | |
| Flounders..... | | | | | 825 | 57 | 1,600 | 80 | 250 | 16 |
| Gizzard shad..... | | | | | | | 9,371 | 97 | | |
| Hickory shad..... | 14,060 | 1,272 | | | | | | | 5,000 | 250 |
| Kingfish..... | | | | | 38,700 | 2,767 | 10,960 | 518 | | |
| Mullet— | | | | | | | | | | |
| Fresh..... | | | 21,200 | \$1,700 | 267,465 | 13,009 | | | | |
| Salted..... | | | 163,909 | 19,450 | | | | | | |
| Perch, white..... | 3,845 | 356 | | | | | 303,514 | 11,927 | 1,400 | 112 |
| Perch, yellow..... | 38,728 | 2,655 | | | | | 101,753 | 3,986 | | |
| Pigfish..... | | | | | 13,419 | 333 | | | 200 | 5 |
| Pike..... | 11,013 | 1,032 | | | | | 4,467 | 469 | | |
| Pinfish..... | | | | | 5,000 | 88 | | | 3,000 | 50 |
| Pompano..... | | | | | 790 | 95 | | | 50 | 6 |
| Shad..... | 26,660 | 4,787 | | | | | 24,000 | 4,000 | 2,000 | 535 |
| Sheepshead..... | | | | | 6,325 | 355 | | | | |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SEINES—Continued.

| Apparatus and species. | Beaufort. | | Brunswick. | | Carteret. | | Currituck. | | Craven. | |
|------------------------|-----------|--------|------------|--------|-----------|--------|------------|---------|---------|--------|
| Haul seines—Con. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Spanish mackerel— | | | | | 4,405 | \$445 | | | | |
| Spot— | | | | | | | | | | |
| Fresh..... | 5,148 | \$255 | 4,600 | \$360 | 181,870 | 6,835 | | | 14,500 | \$780 |
| Salted..... | | | 21,700 | 2,170 | | | | | | |
| Squeteague..... | 164,283 | 5,822 | 100 | 10 | 52,250 | 3,427 | 25,400 | \$1,854 | 16,000 | 1,160 |
| Striped bass..... | 5,894 | 793 | | | | | 15,111 | 1,533 | 5,500 | 440 |
| Suckers..... | 4,800 | 124 | | | | | | | | |
| Sunfish..... | | | | | | | 194,422 | 1,026 | | |
| Yellowtail..... | | | | | 1,500 | 42 | | | | |
| Crabs, soft..... | | | | | 90,600 | 9,020 | | | | |
| Shrimp..... | | | | | 117,000 | 3,254 | | | | |
| Turtles..... | | | | | 2,000 | 11 | | | | |
| Total..... | 481,057 | 22,407 | 211,500 | 23,693 | 847,398 | 42,530 | 1,534,052 | 91,346 | 73,960 | 4,171 |
| Total, by seines..... | 481,057 | 22,407 | 211,500 | 23,693 | 1,252,438 | 45,887 | 1,534,052 | 91,346 | 73,960 | 4,171 |

| Apparatus and species. | Dare. | | Hertford. | | Hyde. | | Martin. | | Onslow. | |
|-----------------------------|---------|---------|-----------|---------|---------|--------|---------|---------|---------|--------|
| Purse seines: Striped bass. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| | 18,000 | \$4,500 | | | | | | | | |
| Haul seines: | | | | | | | | | | |
| Alive— | | | | | | | | | | |
| Fresh..... | | | 54,210 | \$1,501 | | | 30,000 | \$1,500 | | |
| Salted..... | | | | | | | 25,000 | 1,250 | | |
| Black bass..... | 33,184 | \$3,980 | | | | | | | | |
| Bluefish..... | 31,944 | 3,474 | | | 855 | \$100 | | | 2,000 | \$175 |
| Butterfish..... | | | | | | | | | 1,000 | 100 |
| Catfish..... | 900 | 14 | | | | | 600 | 38 | | |
| Croaker..... | 11,151 | 540 | | | | | | | 4,300 | 122 |
| Drum..... | 19,096 | 585 | | | | | | | 3,000 | 22 |
| Flounders..... | | | | | | | | | 300 | 25 |
| Kingfish..... | 6,000 | 300 | | | | | | | 4,000 | 275 |
| Mullet— | | | | | | | | | | |
| Fresh..... | | | | | | | | | 36,000 | 2,400 |
| Salted..... | | | | | | | | | 35,500 | 3,970 |
| Perch, white..... | 41,958 | 1,679 | 702 | 48 | | | 1,000 | 80 | | |
| Perch, yellow..... | 13,985 | 559 | | | | | | | | |
| Pinfish..... | 22,428 | 1,061 | | | 355 | 15 | | | 3,000 | 75 |
| Pinfish..... | 22,049 | 322 | | | | | | | | |
| Pompano..... | 808 | 45 | | | | | | | 500 | 100 |
| Shad..... | | | 125 | 25 | | | | | | |
| Sheep head..... | 120 | 19 | | | | | | | 160 | 20 |
| Spanish mackerel..... | 5,100 | 286 | | | | | | | 300 | 30 |
| Spot—Fresh..... | 34,453 | 1,620 | | | 375 | 15 | | | 21,800 | 665 |
| Squeteague..... | 315,620 | 26,645 | | | 2,300 | 225 | | | 9,400 | 660 |
| Striped bass..... | 5,168 | 409 | | | | | | | | |
| Total..... | 562,915 | 41,563 | 55,136 | 1,374 | 3,885 | 355 | 56,630 | 2,818 | 121,500 | 8,669 |
| Total, by seines..... | 580,915 | 46,083 | 55,136 | 1,374 | 3,885 | 355 | 56,630 | 2,818 | 121,500 | 8,669 |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SEINES—Continued.

| Apparatus and species. | New Hanover. | | Pender. | | Washington. | | Total. | |
|------------------------|--------------|--------|---------|--------|-------------|----------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Purse seines: | | | | | | | | |
| Menhaden | | | | | | | 300,000 | \$1,500 |
| Striped bass | | | | | | | 18,000 | 4,500 |
| Shrimp | | | | | | | 105,040 | 1,857 |
| Total | | | | | | | 423,040 | 7,857 |
| Haul seines: | | | | | | | | |
| Alewives— | | | | | | | | |
| Fresh | | | | | 600,000 | \$30,000 | 930,837 | 38,321 |
| Salted | | | | | 512,200 | 25,610 | 658,200 | 28,504 |
| Black bass | | | | | | | 533,364 | 60,977 |
| Bluefish | 500 | \$62 | 150 | \$13 | | | 43,529 | 4,498 |
| Bowfin | | | | | | | 25,079 | 242 |
| Butterfish | | | | | | | 3,850 | 217 |
| Carp | | | | | | | 123,472 | 4,631 |
| Catfish | 500 | 15 | 1,000 | 30 | 1,267 | 76 | 114,566 | 2,002 |
| Croaker | | | | | | | 74,176 | 2,413 |
| Drum | | | 5,500 | 380 | | | 46,831 | 1,937 |
| Eels | | | | | | | 1,512 | 45 |
| Flounders | 200 | 30 | 4,200 | 290 | | | 7,375 | 498 |
| Gizzard shad | | | | | | | 9,371 | 97 |
| Hickory shad | | | | | | | 19,000 | 1,522 |
| Kingfish | 1,500 | 187 | | | | | 61,160 | 4,077 |
| Mullet— | | | | | | | | |
| Fresh | 20,000 | 1,750 | 102,500 | 9,000 | | | 447,165 | 27,949 |
| Salted | | | 20,500 | 2,190 | | | 219,900 | 25,610 |
| Perch, white | | | | | 2,000 | 160 | 354,509 | 14,362 |
| Perch, yellow | | | | | | | 154,467 | 7,200 |
| Pigfish | | | 8,150 | 633 | | | 47,572 | 2,122 |
| Pike | | | | | | | 15,480 | 1,441 |
| Pinfish | | | | | | | 30,049 | 460 |
| Pompano | 2,300 | 345 | | | | | 4,448 | 591 |
| Shad | | | | | 20,800 | 4,160 | 73,585 | 13,507 |
| Sheepshead | | | | | | | 6,845 | 385 |
| Spanish mackerel | | | | | | | 9,805 | 755 |
| Spot— | | | | | | | | |
| Fresh | 19,000 | 1,450 | 178,200 | 9,940 | | | 458,946 | 21,860 |
| Salted | | | 3,000 | 335 | | | 24,700 | 2,505 |
| Squeteague | 3,500 | 465 | 21,200 | 2,485 | | | 610,053 | 42,753 |
| Striped bass | | | | | | | 31,673 | 3,235 |
| Suckers | | | | | | | 4,890 | 124 |
| Sunfish | | | | | | | 104,422 | 1,026 |
| Yellowtail | 3,000 | 180 | 20,000 | 965 | | | 24,500 | 1,187 |
| Crabs, soft | | | | | | | 80,000 | 9,020 |
| Shrimp | 120,000 | 3,000 | | | | | 237,000 | 6,254 |
| Turtles | | | | | | | 2,000 | 11 |
| Total | 170,500 | 7,484 | 370,500 | 26,505 | 1,136,267 | 60,006 | 5,605,300 | 332,938 |
| Total, by seines | 170,500 | 7,484 | 370,500 | 26,505 | 1,136,267 | 60,006 | 5,605,300 | 332,938 |

BY GILL NETS.

| Species. | Beaufort. | | Bladen. | | Brunswick. | | Camden. | | Carteret. | |
|---------------------|-----------|---------|---------|---------|------------|--------|---------|---------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: Fresh | | | | | | | | | 45,000 | \$2,850 |
| Bluefish | | | | | | | | | 242,455 | 22,068 |
| Bonito | | | | | | | | | 1,015 | 27 |
| Butterfish | | | | | | | | | 8,975 | 452 |
| Cero | | | | | | | | | 1,758 | 95 |
| Croaker | | | | | 300 | \$9 | | | 167,201 | 5,120 |
| Drum | | | | | | | | | 10,250 | 320 |
| Flounders | | | | | 2,300 | 108 | | | 1,475 | 83 |
| Hickory shad | | | | | | | | | 16,408 | 1,169 |
| Kingfish | | | | | 1,100 | 110 | | | 100,213 | 7,106 |
| Menhaden | | | | | | | | | 1,740,000 | 7,395 |
| Mullet: | | | | | | | | | | |
| Fresh | | | | | 6,000 | 400 | | | 67,225 | 4,165 |
| Salted | | | | | 50,000 | 6,000 | | | 22,500 | 4,000 |
| Pigfish: Fresh | | | | | | | | | 128,550 | 4,250 |
| Pinfish | | | | | | | | | 13,380 | 150 |
| Pompano | | | | | | | | | 1,353 | 147 |
| Shad | 10,440 | \$1,740 | 3,990 | \$1,140 | 2,050 | 425 | 17,800 | \$4,450 | 16,124 | 4,792 |
| Sheepshead | | | | | 300 | 18 | | | 9,264 | 538 |
| Spanish mackerel | | | | | | | | | 98,575 | 9,757 |
| Spot: | | | | | | | | | | |
| Fresh | | | | | 3,500 | 130 | | | 538,395 | 22,293 |
| Salted | | | | | 15,000 | 1,200 | | | | |
| Squeteague: Fresh | | | | | 6,000 | 500 | | | 1,121,527 | 95,152 |
| Striped bass | | | | | 1,000 | 100 | | | 25 | 3 |
| Yellowtail | | | | | | | | | 6,608 | 187 |
| Shark hides | | | | | | | | | 19,125 | 2,868 |
| Other aquatic hides | | | | | | | | | 11,050 | 2,157 |
| Shrimp | | | | | | | | | 5,500 | 220 |
| Turtles | | | | | 500 | 13 | | | 2,000 | 13 |
| Total | 10,440 | 1,740 | 3,990 | 1,140 | 88,050 | 9,013 | 17,800 | 4,450 | 4,386,451 | 194,907 |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY GILL NETS—Continued.

| Species. | Chowan. | | Columbus. | | Craven. | | Currituck. | |
|-------------------|---------|--------|-----------|--------|---------|--------|------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: | | | | | | | | |
| Fresh | 4,750 | \$120 | | | | | | |
| Salted | 1,900 | 48 | | | | | | |
| Catfish | | | | | 1,100 | \$22 | | |
| Croaker | | | | | 350 | 17 | | |
| Flounders | | | | | 250 | 15 | | |
| Hickory shad | 15,010 | 1,900 | | | 10,940 | 690 | | |
| Mullet: Fresh | | | | | 17,400 | 1,395 | | |
| Perch: White | | | | | 1,400 | 140 | | |
| Shad | 79,792 | 17,404 | 1,575 | \$450 | 9,288 | 2,433 | 13,284 | \$2,214 |
| Spot: Fresh | | | | | 4,500 | 194 | | |
| Squeteague: Fresh | | | | | 910 | 83 | | |
| Striped bass | 7,980 | 1,500 | | | 500 | 50 | 250 | 50 |
| Total | 109,432 | 21,068 | 1,575 | 450 | 46,638 | 5,039 | 13,534 | 2,264 |

| Species. | Dare. | | Gates. | | Hertford. | | Hyde. | |
|-------------------|---------|---------|---------|--------|-----------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: Fresh | | | 21,688 | \$347 | | | | |
| Bluefish | 15,000 | \$1,200 | | | | | 6,600 | \$748 |
| Drum | 10,500 | 210 | | | | | 250 | 3 |
| Flounders | | | | | | | 225 | 11 |
| Kingfish | | | | | | | 835 | 50 |
| Mullet: Salted | | | | | | | 650 | 169 |
| Piefish: | | | | | | | | |
| Fresh | 15,000 | 600 | | | | | 500 | 25 |
| Salted | 3,125 | 63 | | | | | | |
| Pinfish | 750 | 15 | | | | | | |
| Shad | 151,634 | 43,512 | | | 125 | \$25 | 38,961 | 6,202 |
| Sheepshead | 714 | 50 | | | | | | |
| Spanish mackerel | 1,000 | 50 | | | | | 85 | 10 |
| Spot: | | | | | | | | |
| Fresh | 15,000 | 600 | | | | | 2,500 | 125 |
| Salted | 3,125 | 63 | | | | | | |
| Squeteague: Fresh | 6,667 | 500 | | | | | 14,500 | 1,114 |
| Sturgeon | 1,337 | 328 | | | | | | |
| Sturgeon caviar | 311 | 697 | | | | | | |
| Total | 220,163 | 47,888 | 21,688 | 347 | 125 | 25 | 65,166 | 8,457 |

| Species. | New Hanover. | | Onslow. | | Pamlico. | | Pender. | |
|------------------|--------------|---------|---------|---------|----------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: Fresh | 15,000 | \$1,200 | 177,507 | \$6,250 | | | | |
| Bluefish | | | 3,400 | 280 | | | | |
| Butterfish | | | | | 250 | \$10 | | |
| Croaker | | | 9,050 | 230 | 1,250 | 50 | 400 | \$30 |
| Drum | | | 1,645 | 164 | 5,000 | 60 | | |
| Eel | | | | | | | | |
| Flounders | 100 | 15 | | | | | | |
| Hickory shad | 5,000 | 100 | | | | | | |
| Kingfish | 200 | 25 | 18,250 | 1,220 | | | 300 | 23 |
| Mullet: | | | | | | | | |
| Fresh | 12,000 | 1,000 | 157,024 | 12,465 | 4,000 | 400 | 29,200 | 2,250 |
| Salted | | | 11,500 | 1,262 | 5,800 | 800 | 5,000 | 500 |
| Pigfish: Fresh | 3,000 | 300 | 9,000 | 350 | | | 50 | 3 |
| Shad | 38,600 | 11,275 | | | | | 1,000 | 275 |
| Sheepshead | | | 300 | 15 | 850 | 50 | | |
| Spanish mackerel | 1,500 | 225 | | | 100 | 10 | | |
| Spot: Fresh | 12,000 | 900 | 55,250 | 3,260 | 1,250 | 50 | 25,100 | 1,510 |
| Squeteague: | | | | | | | | |
| Fresh | | | 94,451 | 8,593 | 21,850 | 1,315 | 600 | 45 |
| Salted | | | | | 80 | 10 | | |
| Sturgeon | 3,500 | 420 | | | | | | |
| Sturgeon caviar | 10 | 10 | | | | | | |
| Yellowtail | | | | | 170 | 5 | | |
| Terapug | | | 150 | 35 | | | | |
| Total | 90,910 | 15,770 | 537,527 | 34,124 | 40,600 | 2,760 | 61,650 | 4,636 |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES,
AND SPECIES—Continued.

BY GILL NETS—Continued.

| Species. | Perquimans. | | Tyrrell. | | Washington. | | Total. | |
|---------------------|-------------|---------|----------|--------|-------------|--------|-----------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: | | | | | | | | |
| Fresh | 68,000 | \$1,360 | | | 36,500 | \$815 | 368,445 | \$12,472 |
| Salted | 13,000 | 130 | | | | | 14,900 | 178 |
| Bluefish | | | | | | | 267,515 | 24,296 |
| Bonito | | | | | | | 1,015 | 27 |
| Butterfish | | | | | | | 9,225 | 462 |
| Carp | | | | | 71 | 5 | 71 | 5 |
| Catfish | | | | | 300 | 15 | 1,400 | 37 |
| Cero | | | | | | | 1,758 | 95 |
| Croaker | | | | | | | 178,551 | 5,456 |
| Drum | | | | | | | 32,000 | 593 |
| Eels | | | | | | | 1,645 | 164 |
| Flounders | | | | | | | 4,350 | 232 |
| Hickory shad | | | | | 6,125 | 735 | 53,983 | 4,894 |
| Kingfish | | | | | | | 120,898 | 8,534 |
| Menhaden | | | | | | | 1,740,000 | 7,395 |
| Mullet: | | | | | | | | |
| Fresh | | | | | | | 292,849 | 22,075 |
| Salted | | | | | | | 95,450 | 12,731 |
| Perch: | | | | | | | | |
| White | | | | | | | 1,400 | 140 |
| Yellow | 625 | 50 | | | | | 625 | 50 |
| Pigfish: | | | | | | | | |
| Fresh | | | | | | | 156,100 | 5,528 |
| Salted | | | | | | | 3,125 | 63 |
| Pinfish | | | | | | | 14,130 | 165 |
| Pompano | | | | | | | 1,353 | 147 |
| Shad | 100,600 | 21,920 | 875 | \$175 | 26,844 | 5,253 | 521,982 | 123,685 |
| Sheephead | | | | | | | 11,428 | 671 |
| Spanish mackerel | | | | | | | 101,260 | 10,052 |
| Spot: | | | | | | | | |
| Fresh | | | | | | | 657,495 | 29,062 |
| Salted | | | | | | | 18,125 | 1,263 |
| Squeteague: | | | | | | | | |
| Fresh | | | | | | | 1,266,505 | 107,302 |
| Salted | | | | | | | 80 | 10 |
| Striped bass | 7,250 | 1,450 | 988 | 238 | | | 17,993 | 3,487 |
| Sturgeon | | | | | | | 4,837 | 748 |
| Sturgeon caviar | | | | | | | 321 | 707 |
| Yellowtail | | | | | | | 6,778 | 192 |
| Shark hides | | | | | | | 19,125 | 2,868 |
| Other aquatic hides | | | | | | | 1,050 | 157 |
| Shrimp | | | | | | | 5,500 | 220 |
| Terrapin | | | | | | | 150 | 35 |
| Turtles | | | | | | | 2,500 | 26 |
| Total | 198,475 | 21,910 | 1,863 | 413 | 60,810 | 6,823 | 5,995,917 | 386,224 |

BY POUND NETS.

| Species. | Beaufort. | | Bertie. | | Carteret. | | Chowan. | | Currituck. | |
|------------------|-----------|---------|---------|---------|-----------|---------|-----------|---------|------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: | | | | | | | | | | |
| Fresh | 189,500 | \$5,790 | 211,845 | \$1,209 | 30,636 | \$1,394 | 4,742,768 | \$8,295 | 49,305 | \$2,270 |
| Salted | | | 216,030 | 5,905 | | | 3,228,125 | 87,720 | 12,083 | 416 |
| Angelfish | | | | | 3,800 | 155 | | | | |
| Bluefish | | | | | 1,000 | 90 | | | | |
| Bonito | | | | | 2,000 | 80 | | | | |
| Butterfish | 70,009 | 4,128 | | | 57,224 | 3,680 | | | | |
| Catfish | 6,400 | 160 | 982 | 20 | | | 62,727 | 2,218 | 8,125 | 375 |
| Cero | | | | | 500 | 50 | | | | |
| Crevalla | | | | | 204 | 11 | | | | |
| Croaker | | | | | 45,500 | 1,355 | | | | |
| Drum | | | | | 2,000 | 37 | | | | |
| Eels | 835 | 25 | | | | | 6,860 | 549 | | |
| Flounders | 5,800 | 348 | | | 2,550 | 148 | | | 3,348 | 250 |
| Gizzard shad | | | | | | | 34,629 | 1,036 | | |
| Hickory shad | 2,700 | 243 | 628 | 31 | 6,703 | 280 | 43,273 | 3,932 | | |
| Kingfish | | | | | 1,750 | 85 | | | | |
| Menhaden | | | | | 2,000 | 12 | | | | |
| Perch: | | | | | | | | | | |
| White | 2,785 | 257 | 2,261 | 121 | | | 72,800 | 6,333 | 7,249 | 319 |
| Yellow | 1,757 | 123 | | | | | | | 2,416 | 106 |
| Pigfish | | | | | 500 | 18 | | | | |
| Pike | | | | | | | 294 | 28 | | |
| Pompano | 700 | 60 | | | 625 | 90 | | | | |
| Shad | 44,017 | 7,743 | 5,396 | 1,182 | 37,870 | 8,961 | 93,680 | 17,332 | 13,812 | 3,125 |
| Sheephead | | | | | 1,090 | 60 | | | | |
| Spanish mackerel | | | | | 6,850 | 620 | | | | |
| Spot | | | | | 2,000 | 60 | | | | |
| Squeteague | 150,600 | 4,912 | | | 288,019 | 14,314 | | | | |
| Striped bass | 18,807 | 2,623 | 323 | 50 | 970 | 130 | 9,898 | 1,981 | 34,063 | 5,313 |
| Sturgeon | | | | | 540 | 27 | | | | |
| Suckers | | | 131 | 8 | | | 8,603 | 383 | | |
| Turtles | | | | | 3,500 | 20 | | | | |
| Total | 492,969 | 24,422 | 437,585 | 11,527 | 497,841 | 31,677 | 8,303,837 | 219,807 | 130,401 | 12,181 |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY POUND NETS—Continued.

| Species. | Craven. | | Dare. | | Gates. | | Hertford. | | Hyde. | |
|-----------------------|---------|--------|-----------|----------|---------|--------|-----------|---------|---------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: | | | | | | | | | | |
| Fresh..... | 200 | \$10 | 777,636 | \$36,700 | 52,000 | \$832 | 162,656 | \$3,904 | 87,706 | \$3,054 |
| Salted..... | | | 128,355 | 4,347 | | | | | | |
| Angelfish..... | 50 | 2 | | | | | | | 5,125 | 183 |
| Black bass..... | | | 3,686 | 442 | | | | | | |
| Butterfish..... | 30,000 | 1,200 | 437,473 | 12,345 | | | | | 39,626 | 978 |
| Catfish..... | 100 | 2 | 33,081 | 1,631 | | | | | 2,560 | 64 |
| Caviar..... | | | 350 | 790 | | | | | | |
| Croaker..... | | | 5,387 | 186 | | | | | 1,993 | 43 |
| Drum..... | | | | | | | | | 1,100 | 11 |
| Eels..... | | | | | | | | | 333 | 10 |
| Flounders..... | 100 | 4 | 10,567 | 977 | | | | | 10,556 | 383 |
| Hickory shad..... | 1,000 | 50 | 7,467 | 684 | | | | | 15,112 | 730 |
| Kingfish..... | | | 11,815 | 420 | | | | | 2,500 | 69 |
| Perch: | | | | | | | | | | |
| White..... | 300 | 30 | 29,701 | 1,195 | | | 792 | 48 | 3,078 | 277 |
| Yellow..... | | | 9,900 | 399 | | | | | 700 | 49 |
| Pigfish..... | | | | | | | | | 2,250 | 55 |
| Pompano..... | 25 | 2 | 204 | 12 | | | | | 1,280 | 92 |
| Shad..... | 2,695 | 665 | 729,636 | 175,760 | 600 | 120 | | | 70,866 | 12,194 |
| Spanish mackerel..... | 250 | 200 | 21,873 | 1,761 | | | | | 2,902 | 232 |
| Spot..... | 300 | 15 | 629 | 12 | | | | | 450 | 10 |
| Squeteague..... | 20,000 | 800 | 578,951 | 20,555 | | | | | 133,164 | 3,648 |
| Striped bass..... | 375 | 75 | 125,572 | 18,167 | | | | | 10,829 | 1,509 |
| Sturgeon..... | | | 1,539 | 199 | | | | | | |
| Total..... | 55,365 | 3,055 | 2,922,822 | 276,782 | 52,600 | 952 | 163,448 | 3,952 | 392,130 | 23,591 |

| Species. | Pamlico. | | Perquimans. | | Tyrrell. | | Washington. | | Total. | |
|-----------------------|----------|--------|-------------|---------|-----------|----------|-------------|---------|------------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: | | | | | | | | | | |
| Fresh..... | 3,750 | \$125 | 82,000 | \$1,640 | 762,350 | \$10,417 | 31,000 | \$1,044 | 7,183,952 | \$167,664 |
| Salted..... | | | 26,000 | 260 | 1,151,383 | 27,623 | 308,791 | 7,411 | 5,070,776 | 133,913 |
| Angelfish..... | | | | | | | | | 8,975 | 330 |
| Black bass..... | | | | | | | | | 3,686 | 442 |
| Bluefish..... | | | | | | | | | 1,000 | 90 |
| Bonito..... | | | | | | | | | 2,000 | 80 |
| Butterfish..... | 80,000 | 1,645 | | | | | | | 715,232 | 23,976 |
| Carp..... | | | | | | | 2,357 | 165 | 2,357 | 165 |
| Catfish..... | | | | | 6,350 | 384 | 12,180 | 609 | 132,505 | 5,460 |
| Caviar..... | | | | | | | | | 350 | 790 |
| Cero..... | | | | | | | | | 500 | 50 |
| Crevalle..... | | | | | | | | | 204 | 11 |
| Croaker..... | 5,000 | 100 | | | | | | | 57,880 | 1,684 |
| Drum..... | 6,065 | 50 | | | | | | | 9,765 | 98 |
| Eels..... | | | | | | | 2,316 | 251 | 10,358 | 815 |
| Flounders..... | | | | | | | 650 | 52 | 42,571 | 2,162 |
| Gizzard shad..... | | | | | | | 525 | 24 | 35,154 | 1,057 |
| Hickory shad..... | | | | | | | 8,517 | 1,022 | 85,400 | 6,972 |
| Kingfish..... | | | | | | | | | 16,065 | 574 |
| Menhaden..... | | | | | | | | | 2,000 | 12 |
| Perch: | | | | | | | | | | |
| White..... | | | | | 8,896 | 838 | 28,900 | 2,890 | 156,852 | 12,308 |
| Yellow..... | | | 1,250 | 100 | | | | | 16,023 | 777 |
| Pigfish..... | | | | | | | | | 2,850 | 73 |
| Pike..... | | | | | | | | | 294 | 28 |
| Pompano..... | | | | | | | | | 2,881 | 256 |
| Shad..... | 20,250 | 3,750 | 25,000 | 5,000 | 875 | 175 | 17,715 | 3,472 | 1,061,382 | 239,479 |
| Sheepshead..... | | | | | | | | | 1,000 | 60 |
| Spanish mackerel..... | 1,000 | 100 | | | | | | | 32,875 | 2,913 |
| Spot..... | | | | | | | | | 3,379 | 97 |
| Squeteague..... | 177,100 | 4,130 | | | | | | | 1,347,843 | 48,359 |
| Striped bass..... | | | 2,000 | 100 | 987 | 237 | 6,150 | 1,200 | 210,281 | 31,785 |
| Sturgeon..... | | | | | | | | | 2,070 | 226 |
| Sucker..... | | | | | | | 2,750 | 165 | 11,574 | 556 |
| Turtle..... | | | | | | | | | 3,500 | 20 |
| Total..... | 291,965 | 9,990 | 136,250 | 7,400 | 1,920,841 | 39,671 | 422,775 | 18,372 | 16,233,529 | 683,292 |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY FYKE NETS.

| Species. | Camden. | | Currituck. | | Gates. | |
|-------------------|---------|--------|------------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives..... | | | 6,710 | \$167 | | |
| Black bass..... | | | 14,075 | 1,718 | | |
| Bowfin..... | | | 8,393 | 77 | | |
| Carp..... | | | 27,269 | 818 | | |
| Catfish..... | 2,400 | \$120 | 35,226 | 528 | 312 | \$25 |
| Crappie..... | | | | | 340 | 68 |
| Perch: | | | | | | |
| White..... | 2,300 | 230 | 101,277 | 4,050 | | |
| Yellow..... | | | 52,356 | 2,095 | 312 | 25 |
| Pike..... | | | 4,778 | 429 | | |
| Striped bass..... | | | 1,943 | 253 | | |
| Sunfish..... | | | 19,558 | 176 | | |
| Total..... | 4,700 | 350 | 271,615 | 10,311 | 964 | 118 |

| Species. | Perquimans. | | Tyrrell. | | Washington. | | Total. | |
|-------------------|-------------|--------|----------|--------|-------------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives..... | | | | | | | 6,710 | \$167 |
| Black bass..... | | | | | | | 14,075 | 1,718 |
| Bowfin..... | | | | | | | 8,393 | 77 |
| Carp..... | | | | | | | 27,269 | 818 |
| Catfish..... | | | | | 600 | \$36 | 38,538 | 709 |
| Crappie..... | 304 | \$30 | 4,700 | \$170 | | | 5,340 | 568 |
| Perch: | | | | | | | | |
| White..... | | | | | 750 | 60 | 104,327 | 4,340 |
| Yellow..... | | | | | | | 52,698 | 2,120 |
| Pike..... | | | | | | | 4,778 | 429 |
| Striped bass..... | | | | | | | 1,943 | 253 |
| Sunfish..... | | | | | | | 19,558 | 176 |
| Total..... | 300 | 30 | 4,700 | 470 | 1,350 | 96 | 283,629 | 11,375 |

BY STOP NETS.

| Species. | Brunswick. | | Total. | | Species. | Brunswick. | | Total. | |
|-----------------|------------|--------|---------|--------|-----------------|------------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | | Pounds. | Value. | Pounds. | Value. |
| Croaker..... | 200 | \$9 | 200 | \$9 | Squeteague..... | 500 | \$34 | 500 | \$34 |
| Drum..... | 1,500 | 73 | 1,500 | 73 | Tautog..... | 150 | 9 | 150 | 9 |
| Flounders..... | 4,500 | 265 | 4,500 | 265 | Crabs: | | | | |
| Kingfish..... | 150 | 8 | 150 | 8 | Hard..... | 650 | 20 | 650 | 20 |
| Mullet..... | 1,500 | 80 | 1,500 | 80 | Soft..... | 40 | 10 | 40 | 10 |
| Pigfish..... | 150 | 9 | 150 | 9 | Total..... | 10,840 | 605 | 10,840 | 605 |
| Sheepshead..... | 1,500 | 88 | 1,500 | 88 | | | | | |

BY LINES.

| Apparatus and species. | Brunswick. | | Carteret. | | Dare. | |
|------------------------------|------------|--------|-----------|--------|---------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Hand lines: | | | | | | |
| Bluefish..... | | | 1,300 | \$100 | | |
| Croaker..... | | | 4,200 | 110 | | |
| Flounders..... | | | 325 | 25 | | |
| Pigfish..... | | | 7,500 | 175 | | |
| Sea bass..... | 1,000 | \$70 | 12,150 | 1,038 | | |
| Sheepshead..... | | | 450 | 35 | | |
| Spanish mackerel..... | | | 5,000 | 500 | | |
| Spot..... | 150 | 7 | | | | |
| Squeteague..... | | | 41,800 | 3,375 | | |
| Total..... | 1,150 | 77 | 72,725 | 5,358 | | |
| Trot lines: Crabs, hard..... | | | | | 142,260 | \$1,778 |
| Total, by lines..... | 1,150 | 77 | 72,725 | 5,358 | 142,260 | 1,778 |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY LINES—Continued.

| Apparatus and species. | New Hanover. | | Onslow. | | Pender. | | Total. | |
|------------------------------|--------------|--------|---------|--------|---------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Hand lines: | | | | | | | | |
| Bluefish..... | | | | | 500 | \$38 | 1,800 | \$138 |
| Croaker..... | | | | | 800 | 30 | 5,000 | 140 |
| Drum..... | 8,000 | \$480 | | | 800 | 40 | 8,800 | 520 |
| Flounders..... | 5,000 | 750 | | | | | 5,325 | 775 |
| Grunt..... | 15,000 | 1,150 | | | | | 15,000 | 1,150 |
| Kingfish..... | 300 | 37 | | | | | 300 | 37 |
| Pigfish..... | 45,000 | 4,300 | | | 2,500 | 185 | 53,000 | 4,860 |
| Sailor's choice..... | 6,000 | 600 | | | | | 6,000 | 600 |
| Sea bass..... | 50,000 | 5,000 | 200 | \$25 | 800 | 70 | 64,150 | 6,203 |
| Sheepshead..... | 5,000 | 600 | | | | | 5,450 | 635 |
| Spanish mackerel..... | | | | | | | 5,000 | 500 |
| Spot..... | | | | | | | 150 | 7 |
| Squeteague..... | 10,000 | 1,300 | 45 | 5 | 2,000 | 240 | 53,845 | 4,920 |
| Turtles..... | 400 | 20 | | | | | 400 | 20 |
| Total..... | 144,700 | 14,437 | 245 | 30 | 7,400 | 603 | 226,220 | 20,505 |
| Set lines: Catfish..... | 17,500 | 975 | | | | | 17,500 | 975 |
| Trot lines: Crabs, hard..... | | | | | | | 142,290 | 1,778 |
| Total, by lines.. | 162,200 | 15,412 | 245 | 30 | 7,400 | 603 | 386,010 | 23,258 |

BY OTTER TRAWLS.

| Species. | Brunswick. | | Carteret. | | Total. | |
|-----------------|------------|--------|-----------|---------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Croaker..... | 1,000 | \$25 | | | 1,000 | \$25 |
| Flounders..... | 2,000 | 60 | | | 2,000 | 60 |
| Kingfish..... | 2,000 | 60 | | | 2,000 | 60 |
| Spot..... | 3,000 | 90 | | | 3,000 | 90 |
| Squeteague..... | 2,000 | 60 | | | 2,000 | 60 |
| Shrimps..... | 10,000 | 10,800 | 222,580 | \$1,054 | 232,580 | 11,554 |
| Total..... | 17,000 | 11,095 | 222,580 | 4,054 | 592,580 | 15,149 |

BY DREDGES AND CRAB DRAGS.

| Apparatus and species. | Beaufort. | | Carteret. | | Hyde. | |
|---|-----------|---------|-----------|----------|---------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Oyster dredges: Oysters, market, public.. | 20,405 | \$1,165 | | | 7,000 | \$400 |
| Seallop dredges: Seallops..... | | | 404,448 | \$20,736 | | |
| Total..... | 20,405 | 1,165 | 404,448 | 20,726 | 7,000 | 400 |
| Crab drags: Crabs, soft..... | | | 38,660 | 3,725 | | |
| | | | | | | |
| Apparatus and species. | Onslow. | | Pamlico. | | Total. | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Oyster dredges: Oysters, market, public.. | | | 103,250 | \$4,620 | 130,653 | \$6,185 |
| Seallop dredges: Seallops..... | 7,260 | \$850 | | | 411,708 | 30,576 |
| Total..... | 7,260 | 850 | 103,250 | 4,620 | 542,363 | 36,761 |
| Crab drags: Crabs, soft..... | | | | | 38,660 | 3,725 |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY TONGS, RAKES, AND HAND.

| Apparatus and species. | Beaufort. | | Brunswick. | | Carteret. | | Dare. | | Hyde. | |
|------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Tongs: | | | | | | | | | | |
| Clams, hard..... | | | 4,000 | \$750 | 3,000 | \$845 | | | | |
| Oysters, market, public..... | 1,400 | \$100 | | | 275,884 | 7,368 | 39,900 | \$2,850 | 24,500 | \$1,300 |
| Total..... | 1,400 | 100 | 4,000 | 750 | 278,884 | 8,213 | 39,900 | 2,850 | 24,500 | 1,300 |
| Rakes: | | | | | | | | | | |
| Clams, hard..... | | | 40,000 | 7,600 | 43,576 | 7,127 | 6,400 | 1,200 | | |
| Scallops..... | | | | | 900 | 105 | | | | |
| Total..... | | | 40,000 | 7,600 | 44,476 | 7,232 | 6,400 | 1,200 | | |
| Hand: | | | | | | | | | | |
| Clams, hard..... | | | | | 600 | 151 | | | | |
| Oysters, market, public..... | | | 4,725 | 500 | 90,559 | 2,180 | | | | |
| Scallops..... | | | | | 10,224 | 937 | | | | |
| Terrapin..... | | | | | 60 | 57 | | | | |
| Total..... | | | 4,725 | 500 | 101,443 | 3,305 | | | | |

| Apparatus and species. | New Hanover. | | Onslow. | | Pamlico. | | Pender. | | Total. | |
|------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Tongs: | | | | | | | | | | |
| Clams, hard..... | | | 2,000 | \$485 | | | | | 9,000 | \$2,080 |
| Oysters, market— | | | | | | | | | | |
| Public..... | | | 18,025 | 3,050 | 54,684 | \$2,210 | | | 414,393 | 16,878 |
| Private..... | | | 14,700 | 2,500 | 3,500 | 400 | | | 18,200 | 2,900 |
| Total..... | | | 34,725 | 6,035 | 58,184 | 2,610 | | | 441,593 | 21,858 |
| Rakes: | | | | | | | | | | |
| Clams, hard..... | 48,000 | \$14,500 | 3,600 | 1,010 | | | 35,200 | \$9,800 | 176,776 | 41,237 |
| Oysters, market, public..... | | | | | | | 7,000 | 500 | 7,000 | 500 |
| Scallops..... | | | | | | | | | 900 | 105 |
| Total..... | 48,000 | 14,500 | 3,600 | 1,010 | | | 42,200 | 10,300 | 184,676 | 41,812 |
| Hand: | | | | | | | | | | |
| Clams, hard..... | | | 11,200 | 3,150 | | | | | 11,800 | 3,281 |
| Oysters, market, public..... | 10,500 | 600 | 6,125 | 700 | | | 7,000 | 500 | 118,909 | 4,480 |
| Scallops..... | | | | | | | | | 10,224 | 937 |
| Terrapin..... | | | | | | | | | 60 | 57 |
| Total..... | 10,500 | 600 | 17,325 | 3,850 | | | 7,000 | 500 | 140,993 | 8,755 |

BY POTS AND GIGS.

| Apparatus and species. | Beaufort. | | Carteret. | | Craven. | | Currituck. | |
|------------------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Pots: Eels..... | 36,817 | \$1,006 | 1,500 | \$150 | 500 | \$40 | 112,581 | \$10,268 |
| Gigs: Flounders..... | | | 3,000 | 230 | | | | |

| Apparatus and species. | Dare. | | New Hanover. | | Onslow. | | Pender. | | Total. | |
|------------------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Pots: Eels..... | 8,000 | \$680 | | | 1,648 | \$165 | | | 161,016 | \$12,309 |
| Gigs: Flounders..... | | | 5,000 | \$750 | 4,060 | 310 | 13,000 | \$1,730 | 25,000 | 3,030 |

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SCOOP, DIP, AND BOW NETS.

| Apparatus and species. | Bladen. | | Carteret. | | Halifax. | |
|-----------------------------|---------|--------|-----------|--------|----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Scoop and dip nets: | | | | | | |
| Shad..... | 87 | \$25 | | | | |
| Crabs— | | | | | | |
| Hard..... | | | 2,000 | \$150 | | |
| Soft..... | | | 101,996 | 11,066 | | |
| Total..... | 87 | 25 | 103,996 | 11,216 | | |
| Bow nets: Striped bass..... | | | | | 6,635 | \$2,770 |

| Apparatus and species. | New Hanover. | | Washington. | | Total. | |
|-----------------------------|--------------|--------|-------------|----------|---------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Scoop and dip nets: | | | | | | |
| Alewives..... | | | 250,000 | \$20,000 | 250,000 | \$20,000 |
| Shad..... | | | | | 87 | 25 |
| Crabs— | | | | | | |
| Hard..... | 665 | \$35 | | | 2,665 | 185 |
| Soft..... | | | | | 101,996 | 11,066 |
| Total..... | 665 | 35 | 250,000 | 20,000 | 357,748 | 31,276 |
| Bow nets: Striped bass..... | | | | | 6,635 | 2,770 |

INDUSTRIES.

Menhaden industry.—In 1918 there were 21 factories in operation as compared with 9 in 1902 and 6 in 1897. These 21 factories were valued at \$905,436, employing cash capital to the amount of \$66,800, and gave employment to 599 persons, to whom \$260,037 were paid in wages. These plants handled 179,910,599 pounds of menhaden, valued at \$1,306,489. Manufactured products included 979,068 gallons of oil, valued at \$761,588, of which 720 gallons, valued at \$540, was shark oil; and 23,088 tons of dried and acidulated scrap, valued at \$1,290,614. Other by-products of the fisheries of the State included 3,100 tons of ground oyster shells, valued at \$18,600, and 20,175 pounds of shark and other aquatic hides, valued at \$3,025, the total value of by-products being \$2,073,827.

Wholesale trade.—In 1918 there were 46 wholesale fishery establishments in the coastal region of North Carolina handling fresh and salt fish, oysters, clams, and other fishery products, valued at \$158,950, with a cash capital amounting to \$61,750, and engaging 208 persons to whom \$85,475 were paid in wages.

Canning industry.—There were 8 establishments, valued at \$130,715, engaged in canning fishery products and the crushing of oyster shells, employing working capital to the amount of \$30,500, and engaging 500 persons to whom \$49,100 were paid in wages. The products included canned oysters to the value of \$112,334; canned shrimp to the value of \$39,576; canned alewife or river herring roe to the value of \$4,070; canned redfish or red drum to the value of \$450; 392,667 pounds of salted alewives or river herring to the value of \$7,068; and 3,100 tons of crushed oyster shells to the value of \$18,600. The important features of each of the above shore industries are shown in the appended tables.

INDUSTRIES OF NORTH CAROLINA IN 1918.

MENHADEN INDUSTRY.

| Item. | Number. | Value. | Item. | Number. | Value. |
|----------------------|---------|-----------|----------------------------|----------------------|-----------|
| Establishments..... | 21 | \$905,436 | PRODUCTS. | | |
| Cash capital..... | | 66,800 | Oil.....gallons.. | ¹ 979,068 | \$761,588 |
| Persons engaged..... | 599 | | Dry scrap.....tons.. | 9,488 | 674,850 |
| Wages paid..... | | 260,037 | Acidulated scrap....do.... | 13,600 | 615,764 |

WHOLESALE TRADE IN FRESH AND SALTED FISH, OYSTERS, CLAMS, SCALLOPS, AND CRABS.

| | | | | | |
|---------------------|----|-----------|----------------------|-----|----------|
| Establishments..... | 46 | \$153,950 | Persons engaged..... | 208 | |
| Cash capital..... | | 61,750 | Wages paid..... | | \$85,475 |

PREPARED FISHERY PRODUCTS AND CERTAIN BY-PRODUCTS.

| | | | | | |
|--------------------------|---------------------|-----------|-----------------------------|--------------------|----------|
| Establishments..... | 8 | \$130,715 | Shrimp, canned: | | |
| Cash capital..... | | 30,500 | No. 1 cans.....cases.. | ³ 9,200 | \$38,256 |
| Persons engaged..... | 500 | | No. 1½ cans.....do.... | ¹ 550 | 1,320 |
| Wages paid..... | | 49,100 | Total..... | | 39,576 |
| PRODUCTS. | | | | | |
| Oysters, canned: | | | Alewife roe, canned: No. 2 | | |
| 4-ounce cans.....cases.. | ² 721 | 1,665 | cans.....cases.. | ² 1,100 | 4,070 |
| Do.....do..... | ³ 1,700 | 8,500 | Redfish, canned: No. 2 | | |
| 5-ounce cans.....do.... | ² 23,389 | 45,034 | cans.....cases.. | ² 200 | 450 |
| Do.....do..... | ³ 5,000 | 26,500 | Alewives, salted...pounds.. | 392,667 | 7,068 |
| 6-ounce cans.....do.... | ² 526 | 2,420 | Oyster shells, crushed (ag- | | |
| 10-ounce cans.....do.... | ² 5,643 | 28,215 | ricultural lime)...pounds.. | 6,200,000. | 18,600 |
| Total..... | | 112,334 | | | |

¹ Includes 720 gallons of shark oil, valued at \$540.³ Four dozen cans per case.² Two dozen cans per case.

FISHERIES OF SOUTH CAROLINA.

The coastal fisheries of South Carolina are less extensive than those of the other South Atlantic States, the products representing only 1.13 per cent of the total quantity and 3.88 per cent of the total value for the region. In 1918 the number of persons employed in the fisheries of this State was 2,000, of whom 103 were on fishing vessels, 20 on vessels transporting fishery products, 1,121 in the shore and boat fisheries, and 756 shoresmen in the wholesale fish establishments and other fishery industries. Compared with 1902, there has been a decrease of 1,713 persons, or 46.14 per cent.

The total investment of the fisheries of the State was \$221,251. This included 43 fishing and transporting vessels, valued at \$39,000, of a net tonnage of 505 tons, and with outfits valued at \$7,840; 690 boats, valued at \$36,410; fishing apparatus used on vessels and boats to the value of \$22,126; shore and accessory property worth \$95,775, and working cash capital to the value of \$20,100.

The total yield of the fisheries in 1918 was 3,746,932 pounds, valued at \$207,690, representing a decrease as compared with 1902 of 4,427,531 pounds, or 54.16 per cent in quantity, and \$55,333, or 21.03 per cent in value. The five most important species arranged in order of value were as follows: Oysters, 2,783,830 pounds, or 397,690 bushels, valued at \$96,542; shad, 167,462 pounds, valued at \$29,085;

sturgeon, including sturgeon caviar, 117,890 pounds, valued at \$22,025; mullet, fresh and salted, 200,750 pounds, valued at \$19,129; and sea bass, 132,000 pounds, valued at \$13,200. Compared with 1902, there has been a decrease in the take of oysters of 292,010 bushels; of shad, of 266,671 pounds; an increase in the catch of sturgeon of 33,275 pounds, but a decrease of 9,535 pounds in the production of caviar; an increase in the catch of mullet of 62,150 pounds; and a decrease in the catch of sea bass amounting to 577,545 pounds. For years there has been a small fishery for sharks for food, the catch in 1918 amounting to 20,000 pounds, a decrease of 70,000 pounds as compared with 1902.

FISHERIES BY COUNTIES.

The following table gives, by counties, the number of persons employed, investment, and products of the fisheries of South Carolina in 1918.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES.

| Item. | Beaufort. | | Charleston. | | Colleton. | |
|-------------------------------------|-----------|----------|-------------|---------|-----------|---------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 81 | | 6 | | | |
| On vessels transporting..... | | | 20 | | | |
| In shore fisheries..... | 277 | | 358 | | 80 | |
| Shoresmen..... | 444 | | 299 | | | |
| Total..... | 802 | | 683 | | 80 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Gasoline..... | | | 2 | \$3,005 | | |
| Tonnage..... | | | 24 | | | |
| Outfit..... | | | | 275 | | |
| Sail..... | 33 | \$20,995 | | | | |
| Tonnage..... | 357 | | | | | |
| Outfit..... | | 4,415 | | | | |
| Vessels transporting: Gasoline..... | | | 7 | 11,000 | | |
| Tonnage..... | | | 74 | | | |
| Outfit..... | | | | 1,350 | | |
| Boats: | | | | | | |
| Sail and row..... | 286 | \$,760 | 248 | 4,025 | 40 | \$1,000 |
| Power..... | | | 24 | 10,900 | 2 | 800 |
| Apparatus, vessel fisheries: | | | | | | |
| Tongs..... | 81 | 143 | | | | |
| Grabs..... | 78 | 78 | 6 | 6 | | |
| Apparatus, shore fisheries: | | | | | | |
| Haul seines..... | | | 4 | 60 | | |
| Gill nets..... | 14 | 800 | 25 | 2,800 | 41 | 1,570 |
| Cast nets..... | | | 71 | 155 | | |
| Lines..... | | 10 | | 505 | | |
| Other trawls..... | | | 1 | 50 | | |
| Tongs and rakes..... | 196 | 1,095 | 8 | 35 | | |
| Grabs..... | 243 | 242 | 102 | 169 | | |
| Shore and accessory property..... | | 55,915 | | 23,045 | | 1,200 |
| Cash capital..... | | 8,100 | | 10,500 | | |
| Total..... | | 100,853 | | 77,821 | | 4,570 |
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Black drum..... | | | 5,000 | \$225 | | |
| Bluefish..... | | | 1,500 | 140 | | |
| Catfish..... | | | 2,300 | 100 | | |
| Croakers..... | | | 300 | 65 | | |
| Crab..... | 3,500 | \$275 | 8,800 | 585 | | |
| Flounder..... | | | 1,000 | 130 | | |
| Grouper..... | | | 100 | 6 | | |
| King whiting..... | 2,525 | 300 | 35,650 | 4,250 | | |
| Mullet, fresh..... | | | 3,300 | 125 | | |
| Pinfish or sailor's choice..... | | | 2,000 | 130 | | |
| Porcupine..... | | | 2,000 | 139 | | |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES—Continued.

| Item. | Beaufort. | | Charleston. | | Colleton. | |
|--------------------------------|-----------|---------|-------------|--------|-----------|---------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. |
| Redfish or red drum..... | | | 1,000 | \$60 | | |
| Sea bass..... | | | 72,000 | 7,200 | | |
| Shad..... | 8,762 | \$1,400 | 20,700 | 3,260 | 32,600 | \$5,110 |
| Sharks..... | | | 20,000 | 175 | | |
| Sheepshead..... | | | 1,500 | 150 | | |
| Skates..... | | | 2,000 | 15 | | |
| Spot, fresh..... | 1,000 | 75 | 1,200 | 75 | | |
| Squeteague or "sea trout"..... | 5,000 | 600 | 46,500 | 3,640 | | |
| Sturgeon..... | 4,101 | 735 | 324 | 97 | 2,800 | 504 |
| Sturgeon caviar..... | 75 | 56 | | | 70 | 50 |
| Shrimp..... | | | 55,400 | 6,220 | | |
| Crabs: | | | | | | |
| Hard..... | | | 18,000 | 400 | | |
| Soft..... | | | 300 | 75 | | |
| Clams, hard..... | | | 800 | 200 | | |
| Terrapin..... | | | 1,275 | 545 | | |
| Oysters, market: | | | | | | |
| Public..... | 1,562,085 | 49,023 | 1,069,670 | 34,869 | | |
| Private..... | 133,000 | 9,300 | 19,075 | 3,350 | | |
| Total..... | 1,720,048 | 61,764 | 1,391,894 | 66,217 | 35,470 | 5,664 |

| Item. | Georgetown. | | Horry. | | Total. | |
|-------------------------------------|-------------|---------|---------|--------|---------|---------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 16 | | | | 103 | |
| On vessels transporting..... | | | | | 20 | |
| In shore fisheries..... | 192 | | 214 | | 1,121 | |
| Shoemen..... | 8 | | 5 | | 756 | |
| Total..... | 216 | | 219 | | 2,000 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Gasoline..... | 1 | \$4,000 | | | 3 | \$7,005 |
| Tonnage..... | 56 | | | | 74 | |
| Outfit..... | | 1,800 | | | | 2,075 |
| Sail..... | | | | | 33 | 20,995 |
| Tonnage..... | | | | | 357 | |
| Outfit..... | | | | | | 4,415 |
| Vessels transporting: Gasoline..... | | | | | 7 | 11,000 |
| Tonnage..... | | | | | 74 | |
| Outfit..... | | | | | | 1,350 |
| Boats: | | | | | | |
| Sail and row..... | 46 | 1,030 | 29 | \$995 | 639 | 15,810 |
| Power..... | 24 | 8,750 | 1 | 150 | 51 | 20,600 |
| Apparatus, vessel fisheries: | | | | | | |
| Lines..... | | 100 | | | | 100 |
| Tongs..... | | | | | 81 | 443 |
| Crabs..... | | | | | 84 | 84 |
| Apparatus, shore fisheries: | | | | | | |
| Haul seines..... | 5 | 390 | 16 | 2,100 | 25 | 2,550 |
| Gill nets..... | 153 | 11,355 | | | 233 | 16,525 |
| Stop nets..... | | | 2 | 130 | 2 | 130 |
| Bow nets..... | 5 | 25 | | | 5 | 25 |
| Cast nets..... | | | | | 71 | 155 |
| Gigs or spears..... | 26 | 20 | 10 | 7 | 36 | 27 |
| Lines..... | | | | | | 515 |
| Otter trawls..... | 1 | 40 | | | 2 | 90 |
| Tongs and rakes..... | | | | | 204 | 1,131 |
| Crabs..... | | | | | 345 | 351 |
| Shore and accessory property..... | | 4,665 | | 1,450 | | 95,775 |
| Cash capital..... | | 1,530 | | | | 20,100 |
| Total..... | | 33,175 | | 4,892 | | 221,251 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES—Continued.

| Item. | Georgetown. | | Horry. | | Total. | |
|-----------------------------------|-------------|--------|---------|--------|------------------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| PRODUCTS. | | | | | | |
| Alewives..... | 9,500 | \$475 | | | 9,500 | \$475 |
| Black drum..... | | | | | 5,000 | 225 |
| Bluefish..... | | | 1,500 | \$135 | 3,000 | 275 |
| Butterfish..... | | | 600 | 45 | 600 | 45 |
| Catfish..... | 400 | 8 | | | 2,900 | 108 |
| Crevaille..... | | | | | 300 | 65 |
| Croaker..... | 1,500 | 88 | 2,400 | 114 | 16,000 | 1,032 |
| Flounders..... | 14,500 | 875 | 700 | 56 | 16,200 | 1,061 |
| Grunts..... | | | | | 100 | 6 |
| Hickory shad..... | 20,500 | 2,000 | | | 20,500 | 2,000 |
| King whiting..... | 250 | 17 | 1,700 | 140 | 40,125 | 4,707 |
| Mullet: | | | | | | |
| Fresh..... | 35,600 | 2,495 | 19,150 | 1,603 | 58,050 | 4,223 |
| Salted..... | 3,400 | 370 | 139,300 | 14,536 | 142,700 | 14,906 |
| Pinfish or sailer's choice..... | | | 300 | 18 | 2,300 | 148 |
| Porgies..... | | | | | 2,000 | 130 |
| Redfish or red drum..... | | | | | 1,000 | 60 |
| Sea bass..... | 60,000 | 6,000 | | | 132,000 | 13,200 |
| Shad..... | 105,400 | 19,315 | | | 167,462 | 29,085 |
| Sharks..... | | | | | 20,000 | 175 |
| Sheepshead..... | | | 600 | 60 | 2,100 | 210 |
| Skates..... | | | | | 2,000 | 15 |
| Spot: | | | | | | |
| Fresh..... | 20,000 | 1,000 | 14,800 | 1,144 | 37,000 | 2,354 |
| Salted..... | | | 25,550 | 2,085 | 25,550 | 2,085 |
| Squeteague or "sea trout"..... | 3,550 | 245 | 4,100 | 360 | 59,150 | 4,816 |
| Sturgeon..... | 110,000 | 19,800 | | | 117,225 | 21,136 |
| Sturgeon caviar..... | 520 | 783 | | | 665 | 889 |
| Sunfish..... | | | 3,000 | 180 | 3,000 | 180 |
| Yellowtail or "silver perch"..... | 400 | 12 | 500 | 25 | 900 | 37 |
| Shrimp..... | | | | | 55,400 | 6,220 |
| Crabs: | | | | | | |
| Hard..... | | | | | 118,000 | 400 |
| Soft..... | | | | | 2300 | 75 |
| Clams, hard..... | | | | | 3800 | 200 |
| Terrapin..... | | | | | 1,276 | 515 |
| Oysters, market: | | | | | | |
| Public..... | | | | | ⁴ 2,631,755 | 83,892 |
| Private..... | | | | | ⁵ 152,075 | 12,650 |
| Total..... | 385,320 | 53,544 | 214,200 | 20,501 | 3,746,932 | 207,690 |

¹ 54,000 in number. ² 900 in number. ³ 100 bushels. ⁴ 375,965 bushels. ⁵ 21,725 bushels.

FISHERIES BY APPARATUS.

The combined yield of the vessel and shore fisheries of South Carolina in 1918 with all forms of apparatus amounted to 3,746,932 pounds, valued at \$207,690. Grabs were the most productive form of gear used, taking 283,288 bushels of oysters, valued at \$67,139. The catch with gill nets, consisting chiefly of shad and sturgeon, amounted to 350,902 pounds, valued at \$55,827. The catch of oysters with tongs amounted to 114,402 bushels, valued at \$29,403. Sea bass, king whiting, and squeteague were the principal species taken with lines, the total catch with this form of apparatus being 291,575 pounds, valued at \$24,751. The catch with seines was 237,375 pounds, valued at \$22,439, of which 176,350 pounds, valued at \$17,531, were mullet.

The two leading forms of a paratus used in the shore fisheries were gill nets and grabs. Other kinds of gear used in the shore fisheries were seines, cast nets, otter trawls, gigs, stop nets, bow nets, and rakes.

Only three forms of fishing apparatus were employed in the vessel fisheries, namely, grabs, tongs, and lines.

The products of the vessel and shore or boat fisheries are shown in the following tables:

YIELD OF VESSEL FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES.

| Apparatus and species. | Beaufort. | | Charleston. | | Georgetown. | | Total. | |
|-------------------------------------|-----------|----------|-------------|----------|-------------|---------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Lines: Sea bass..... | | | | | 60,000 | \$6,000 | 60,000 | \$6,000 |
| Tongs: Oysters, market, public..... | 440,018 | \$12,216 | | | | | 440,018 | 12,216 |
| Grabs: Oysters, market, public..... | 435,143 | 12,076 | 66,500 | \$13,976 | | | 501,643 | 26,052 |
| Total..... | 875,196 | 21,292 | 66,500 | 13,976 | 60,000 | 6,000 | 1,001,696 | 44,268 |

YIELD OF SHORE FISHERIES OF SOUTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY GILL NETS.

| Species. | Beaufort. | | Charleston. | | Georgetown. | | Colleton. | | Total. | |
|----------------------|-----------|---------|-------------|---------|-------------|--------|-----------|---------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives..... | | | | | 9,500 | \$475 | | | 9,500 | \$475 |
| Catfish..... | | | | | 400 | 8 | | | 400 | 8 |
| Croaker..... | | | | | 700 | 47 | | | 700 | 47 |
| Flounders..... | | | | | 500 | 25 | | | 500 | 25 |
| Hickory shad..... | | | | | 19,250 | 1,900 | | | 19,250 | 1,900 |
| King whiting..... | | | | | 200 | 14 | | | 200 | 14 |
| Mullet: | | | | | | | | | | |
| Fresh..... | | | | | 19,500 | 1,300 | | | 19,500 | 1,300 |
| Salted..... | | | | | 1,000 | 125 | | | 1,000 | 125 |
| Shad..... | 8,762 | \$1,400 | 20,700 | \$3,260 | 105,400 | 19,315 | 32,600 | \$5,110 | 167,462 | 29,085 |
| Spots..... | | | | | 13,000 | 720 | | | 13,000 | 720 |
| Squeteague..... | | | | | 1,500 | 103 | | | 1,500 | 103 |
| Sturgeon..... | 4,101 | 735 | 324 | 97 | 110,000 | 19,800 | 2,800 | 504 | 117,225 | 21,136 |
| Sturgeon caviar..... | 75 | 56 | | | 520 | 783 | 70 | 50 | 665 | 889 |
| Total..... | 12,938 | 2,191 | 21,024 | 3,357 | 281,470 | 44,615 | 35,470 | 5,664 | 350,902 | 55,827 |

BY ALL OTHER APPARATUS.

| Apparatus and species. | Beaufort. | | Charleston. | | Georgetown. | | Horry. | | Total. | |
|-----------------------------|-----------|--------|-------------|--------|-------------|--------|---------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Seines: | | | | | | | | | | |
| Bluefish..... | | | | | | | 1,500 | \$135 | 1,500 | \$135 |
| Butterfish..... | | | | | | | 600 | 45 | 600 | 45 |
| Croaker..... | | | | | 600 | \$41 | 2,400 | 114 | 3,000 | 155 |
| Flounders..... | | | | | 2,000 | 100 | 600 | 48 | 2,600 | 148 |
| King whiting..... | | | | | 50 | 3 | 1,700 | 140 | 1,750 | 143 |
| Mullet— | | | | | | | | | | |
| Fresh..... | | | | | 16,100 | 1,195 | 18,550 | 1,555 | 34,650 | 2,750 |
| Salted..... | | | | | 2,400 | 245 | 139,300 | 14,536 | 141,700 | 14,781 |
| Sailor's choice..... | | | | | | | 300 | 18 | 300 | 18 |
| Sheepshead..... | | | | | | | 600 | 60 | 600 | 60 |
| Spots— | | | | | | | | | | |
| Fresh..... | | | | | 7,000 | 340 | 18,800 | 1,064 | 20,800 | 1,404 |
| Salted..... | | | | | | | 18,550 | 1,535 | 18,550 | 1,535 |
| Squeteague..... | | | | | 2,050 | 143 | 4,100 | 360 | 6,150 | 503 |
| Sunfish..... | | | | | | | 3,000 | 180 | 3,000 | 180 |
| Yellowtail..... | | | | | 400 | 12 | 500 | 25 | 900 | 37 |
| Terrapin..... | | | 1,275 | \$545 | | | | | 1,275 | 545 |
| Total..... | | | 1,275 | 545 | 30,600 | 2,079 | 205,500 | 19,815 | 237,375 | 22,439 |
| Other trawls: | | | | | | | | | | |
| Shrimp..... | | | 30,000 | 1,200 | | | | | 30,000 | 1,200 |
| Bow nets: hickory shad..... | | | | | 1,250 | 100 | | | 1,250 | 100 |

YIELD OF SHORE FISHERIES OF SOUTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY ALL OTHER APPARATUS—Continued.

| Apparatus and species. | Beaufort. | | Charleston. | | Georgetown. | | Horry. | | Total. | |
|-------------------------|-----------|--------|-------------|--------|-------------|--------|---------|--------|-----------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Cast nets: | | | | | | | | | | |
| Catfish..... | | | 1,000 | \$25 | | | | | 1,000 | \$25 |
| Croaker..... | | | 800 | 25 | | | | | 800 | 25 |
| Mullet..... | | | 3,300 | 125 | | | | | 3,300 | 125 |
| Shrimp..... | | | 25,400 | 5,020 | | | | | 25,400 | 5,020 |
| Total..... | | | 30,500 | 5,195 | | | | | 30,500 | 5,195 |
| Stop nets: | | | | | | | | | | |
| Flourishers..... | | | | | | | 100 | \$8 | 100 | 8 |
| Mullet..... | | | | | | | 600 | 48 | 600 | 48 |
| Spots— | | | | | | | | | | |
| Fresh..... | | | | | | | 1,000 | 80 | 1,000 | 80 |
| Salted..... | | | | | | | 7,000 | 550 | 7,000 | 550 |
| Total..... | | | | | | | 8,700 | 686 | 8,700 | 686 |
| Gigs or spears: | | | | | | | | | | |
| Flourishers..... | | | | | 12,000 | \$750 | | | 12,000 | 750 |
| Lines: | | | | | | | | | | |
| Black drum..... | | | 5,000 | 225 | | | | | 5,000 | 225 |
| Bluefish..... | | | 1,500 | 140 | | | | | 1,500 | 140 |
| Catfish..... | | | 1,500 | 75 | | | | | 1,500 | 75 |
| Channel bass..... | | | 1,000 | 60 | | | | | 1,000 | 60 |
| Crevaille..... | | | 300 | 65 | | | | | 300 | 65 |
| Croaker..... | 8,500 | \$275 | 8,000 | 500 | | | | | 11,500 | 835 |
| Flourishers..... | | | 1,000 | 130 | | | | | 1,000 | 130 |
| Grunt..... | | | 100 | 6 | | | | | 100 | 6 |
| King whiting..... | 2,525 | 300 | 35,650 | 4,250 | | | | | 38,175 | 4,550 |
| Porgy..... | | | 2,000 | 130 | | | | | 2,000 | 130 |
| Sailor's choice..... | | | 2,000 | 130 | | | | | 2,000 | 130 |
| Sea bass..... | | | 72,000 | 7,200 | | | | | 72,000 | 7,200 |
| Sheepshead..... | | | 1,500 | 150 | | | | | 1,500 | 150 |
| Spooks..... | 1,000 | 75 | 1,200 | 75 | | | | | 2,200 | 150 |
| Spratling..... | 5,000 | 600 | 46,500 | 3,640 | | | | | 51,500 | 4,240 |
| Sharks..... | | | 20,000 | 175 | | | | | 20,000 | 175 |
| Skates..... | | | 2,000 | 15 | | | | | 2,000 | 15 |
| Crabs— | | | | | | | | | | |
| Hard..... | | | 18,000 | 400 | | | | | 18,000 | 400 |
| Soft..... | | | 300 | 75 | | | | | 300 | 75 |
| Total..... | 12,025 | 1,250 | 219,550 | 17,501 | | | | | 231,575 | 18,751 |
| Tongs: Oysters, market— | | | | | | | | | | |
| Public..... | 304,941 | 11,987 | 1,750 | 250 | | | | | 306,691 | 12,237 |
| Private..... | 46,500 | 3,460 | 8,575 | 1,500 | | | | | 54,075 | 4,950 |
| Total..... | 350,441 | 15,437 | 10,325 | 1,750 | | | | | 360,766 | 17,187 |
| Grabs: Oysters, market— | | | | | | | | | | |
| Public..... | 381,948 | 12,744 | 1,001,420 | 20,643 | | | | | 1,383,368 | 33,387 |
| Private..... | 87,500 | 5,850 | 10,500 | 1,850 | | | | | 98,000 | 7,700 |
| Total..... | 469,448 | 18,594 | 1,011,920 | 22,493 | | | | | 1,481,368 | 41,087 |
| Rakes: Clams, hard..... | | | 800 | 200 | | | | | 800 | 200 |

¹ Taken with the hands.

INDUSTRIES.

Wholesale trade.—In 1918 there were 6 wholesale establishments, valued at \$51,820, with cash capital amounting to \$8,100, employing 59 persons, to whom \$40,678 were paid in wages.

Oyster-canning industry.—In addition to those given above, there were 9 establishments engaged in the canning of oysters and utilization of shells, valued at \$121,925, using cash capital to the amount of

\$12,000, employing 592 persons, to whom \$60,985 were paid in wages during the year. The pack amounted to 2,769,168 cans of various sizes, valued at \$338,843.

The following table contains statistics of the canning industry for South Carolina in 1918:

OYSTER-CANNING INDUSTRY IN SOUTH CAROLINA IN 1918.

| Item. | Number. | Value. | Item. | Number. | Value. |
|--------------------------|--------------------|-----------|---------------------------|---------------------|-----------|
| Establishments..... | 9 | \$121,925 | PRODUCTS—continued. | | |
| Cash capital..... | | 12,000 | Oysters canned—Continued. | | |
| Persons engaged..... | 592 | | 5-ounce cans.....cases.. | ² 50,496 | \$154,028 |
| Wages paid..... | | 60,985 | Do.....do..... | ³ 23,705 | 117,235 |
| PRODUCTS. ¹ | | | 6-ounce cans.....do..... | ⁴ 100 | 800 |
| Oysters canned: | | | 8-ounce cans.....do..... | ² 1,826 | 7,690 |
| 3-ounce cans.....cases.. | ³ 401 | 1,746 | 10-ounce cans.....do..... | ² 9,190 | 45,700 |
| 4-ounce cans.....do..... | ² 880 | 1,822 | Total..... | | 338,843 |
| Do.....do..... | ² 2,289 | 9,822 | | | |

¹ The by-products are included with the statistics for Georgia.

² Two dozen cans per case.

³ Four dozen cans per case.

FISHERIES OF GEORGIA.

In 1918 the fisheries of Georgia gave employment to 1,680 persons, of whom 188 were on fishing and transporting vessels, 476 in the shore fisheries, and 1,016 shoresmen in the wholesale fishery trade and oyster and shrimp canning industry.

The investment amounted to \$769,998, which includes 33 fishing and transporting vessels, valued at \$122,663, with a net tonnage of 552 tons and outfits valued at \$41,866; 412 power and other boats, valued at \$86,205; fishing apparatus employed on vessels and boats, valued at \$17,085; shore and accessory property, valued at \$429,779; and cash capital amounting to \$72,400.

The products amounted to 37,153,953 pounds, valued at \$416,043, and represent an increase of 26,051,343 pounds in quantity and \$56,962 in value as compared with 1902. The 5 most important products, arranged in the order of their value, are as follows: Shrimp, 5,793,465 pounds, valued at \$173,990; menhaden, 29,484,600 pounds, valued at \$88,453; oysters, 1,109,822 pounds, or 158,546 bushels, valued at \$73,913; shad, 100,540 pounds, valued at \$26,960; and sea bass, 292,615 pounds, valued at \$23,765. Compared with 1902, there has been an increase in the catch of shrimp of 5,449,338 pounds in quantity and \$165,582 in value, and an increase in the catch of sea bass amounting to 216,115 pounds in quantity and \$17,683 in value; a decrease in the take of oysters amounting to 7,458,178 pounds, or 1,065,454 bushels, in quantity, and \$146,554 in value; a decrease of 928,510 pounds in quantity of shad and \$48,229 in value; a decrease in the catch of mullet amounting to 115,150 pounds in quantity and \$1,883 in the value; and a decrease in the catch of terrapin amounting to 31,196 pounds in quantity and \$10,682 in value. In 1902 there was no fishery for menhaden in the State.

FISHERIES BY COUNTIES.

The following table shows, by counties, the number of persons employed, number and value of vessels, boats and apparatus used, amount of capital invested, and the quantity and value of the products of the fisheries in 1918.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF GEORGIA IN 1918, BY COUNTIES.

| Item. | Bryan. | | Camden. | | Chatham. | |
|-----------------------------------|---------|---------|------------|----------|-----------|----------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 192 | | 51 | | | |
| In shore fisheries..... | 21 | | 68 | | 183 | |
| Shoremen..... | 191 | | 316 | | | |
| Total..... | 21 | | 361 | | 553 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Gasoline..... | | | 7 | \$56,900 | 7 | \$37,040 |
| Tonnage..... | | | 215 | | 176 | |
| Outfit..... | | | | 28,233 | | 9,308 |
| Sail..... | | | | | 5 | 2,315 |
| Tonnage..... | | | | | 44 | |
| Outfit..... | | | | | | 325 |
| Boats: | | | | | | |
| Sail, row, etc..... | 21 | \$315 | 22 | 1,115 | 186 | 5,850 |
| Power..... | | | 25 | 24,400 | 10 | 2,225 |
| Apparatus, vessel fisheries: | | | | | | |
| Pursegines..... | | | 4 | 4,800 | | |
| Lines..... | | | | | | 105 |
| Otter trawls..... | | | 3 | 160 | | |
| Dredges..... | | | | | 6 | 300 |
| Trawls..... | | | | | 13 | 76 |
| Grabs..... | | | | | 13 | 12 |
| Apparatus, shore fisheries: | | | | | | |
| Gill nets..... | 24 | 735 | 16 | 1,050 | 38 | 1,200 |
| Lines..... | | | | 2 | | |
| Otter trawls..... | | | 23 | 1,200 | | |
| Tonnage..... | | | | | 100 | 805 |
| Grabs..... | | | | | 163 | 162 |
| Shore and accessory property..... | | 25 | | 77,155 | | 194,130 |
| Cash capital..... | | | | 14,060 | | 36,600 |
| Total..... | | 1,075 | | 239,605 | | 230,543 |
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Bluefish..... | | | | | 5,000 | \$300 |
| Cero, or kingfish..... | | | | | 74 | 7 |
| Flounders..... | | | | | 500 | 55 |
| Groupers..... | | | | | 27,758 | 1,019 |
| Grunts..... | | | | | 512 | 26 |
| King whiting..... | | | | | 100 | 12 |
| Menhaden..... | | | 29,484,000 | \$88,455 | | |
| Mullet..... | | | | | 3,000 | 240 |
| Redfish, or red drum..... | | | | | 24 | 4 |
| Red snapper..... | | | | | 111,749 | 7,740 |
| Scup..... | | | | | 12,000 | 960 |
| Sea bass..... | | | 125 | 10 | 201,490 | 23,655 |
| Shad..... | 13,500 | \$3,202 | 61,250 | 18,000 | 14,502 | 3,505 |
| Sharks..... | | | | | 1,280 | 30 |
| Sheepshead..... | | | 175 | 10 | | |
| Squeteague, or "sea trout"..... | | | 850 | 50 | 3,700 | 385 |
| Striped bass..... | | | 125 | 10 | | |
| Tilapia..... | | | | | 35,000 | 2,400 |
| Strippap..... | | | 1,200,818 | 39,046 | | |
| Oyster, market: | | | | | | |
| Public..... | | | 37,800 | 1,400 | 412,930 | 28,394 |
| Private..... | | | | | 201,079 | 24,288 |
| Oysters..... | | | | | 2,731 | 268 |
| Terrapin..... | | | | | 2,030 | 419 |
| Total..... | 13,500 | 3,202 | 31,875,723 | 146,979 | 1,185,468 | 94,217 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF GEORGIA
IN 1918, BY COUNTIES—Continued.

| Item. | Effingham. | | Glynn. | | Liberty. | |
|-------------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| PERSONS ENGAGED. | | | | | | |
| | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> |
| On vessels fishing..... | | | 30 | | | |
| On vessels transporting..... | | | 2 | | | |
| In shore fisheries..... | 3 | | 116 | | 16 | |
| Shoresmen..... | | | 382 | | 37 | |
| Total..... | 3 | | 530 | | 53 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Gasoline..... | | | 13 | \$25,908 | | |
| Tonnage..... | | | 108 | | | |
| Outfit..... | | | | 3,875 | | |
| Vessels transporting, gasoline..... | | | 1 | 500 | | |
| Tonnage..... | | | 9 | | | |
| Outfit..... | | | | 125 | | |
| Boats: | | | | | | |
| Sail, row, etc..... | 3 | \$45 | 23 | 320 | 14 | \$195 |
| Power..... | | | 52 | 46,725 | 1 | 600 |
| Apparatus, vessel fisheries: | | | | | | |
| Otter trawls..... | | | 9 | 545 | | |
| Tongs..... | | | 8 | 60 | | |
| Crabs..... | | | 8 | 12 | | |
| Apparatus, shore fisheries: | | | | | | |
| Haul seines..... | | | 2 | 80 | | |
| Gill nets..... | 3 | 100 | 6 | 15 | 4 | 45 |
| Lines..... | | | | 6 | | |
| Otter trawls..... | | | 48 | 2,400 | | |
| Tongs..... | | | 10 | 75 | 12 | 70 |
| Crabs..... | | | 10 | 15 | 12 | 12 |
| Shore and accessory property..... | | 5 | | 127,764 | | 13,500 |
| Cash capital..... | | | | 18,000 | | 800 |
| Total..... | | 150 | | 226,425 | | 15,222 |
| PRODUCTS. | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Croaker..... | | | 5,600 | \$235 | | |
| Flounders..... | | | 10,000 | 575 | | |
| Hickory shad..... | | | | | 195 | \$25 |
| King whiting..... | | | 26,200 | 1,397 | | |
| Mullet..... | | | 2,500 | 100 | | |
| Redfish, or red drum..... | | | 100 | 6 | | |
| Red snapper..... | | | 600 | 70 | | |
| Sea bass..... | | | 1,000 | 100 | | |
| Shad..... | 1,998 | \$483 | | | 605 | 111 |
| Spot..... | | | 1,100 | 59 | | |
| Squeteague, or "sea trout"..... | | | 27,700 | 2,962 | | |
| Yellowtail, or "silver perch"..... | | | 2,000 | 100 | | |
| Crabs, hard..... | | | 8,455 | 504 | | |
| Shrimp..... | | | 4,412,647 | 132,350 | | |
| Clams, hard..... | | | 120 | 75 | | |
| Oysters, market: | | | | | | |
| Public..... | | | 5,600 | 400 | | |
| Private..... | | | 115,332 | 2,141 | 154,021 | 6,600 |
| Terrapin..... | | | 82 | 35 | | |
| Turtles..... | | | 11,250 | 100 | | |
| Total..... | 1,998 | 483 | 4,630,286 | 141,209 | 154,821 | 6,736 |

| Item. | McIntosh. | | Wayne. | | Total. | |
|------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| PERSONS ENGAGED. | | | | | | |
| | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> |
| On vessels fishing..... | | | | | 186 | |
| On vessels transporting..... | | | | | 2 | |
| In shore fisheries..... | 49 | | 20 | | 476 | |
| Shoresmen..... | 90 | | | | 1,016 | |
| Total..... | 139 | | 20 | | 1,680 | |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF GEORGIA
IN 1918, BY COUNTIES—Continued.

| Item. | McIntosh. | | Wayne. | | Total. | |
|------------------------------------|-----------|--------|---------|--------|------------|-----------|
| INVESTMENT. | | | | | | |
| Vessels fishing: | Number. | Value. | Number. | Value. | Number. | Value. |
| Gasoline..... | | | | | 27 | \$119,848 |
| Tonnage..... | | | | | 499 | |
| Outfit..... | | | | | | 41,416 |
| Sail..... | | | | | 5 | 2,315 |
| Tonnage..... | | | | | 44 | |
| Outfit..... | | | | | | 325 |
| Vessels transporting gasoline.. | | | | | 1 | 500 |
| Tonnage..... | | | | | 9 | |
| Outfit..... | | | | | | 125 |
| Boats: | | | | | | |
| Sail, row, etc..... | 34 | \$860 | 10 | \$105 | 313 | 8,805 |
| Power..... | 11 | 3,490 | | | 99 | 77,400 |
| Apparatus, vessel fisheries: | | | | | | |
| Turse seines..... | | | | | 4 | 4,800 |
| Lines..... | | | | | | 105 |
| Other trawls..... | | | | | 12 | 705 |
| Dredges..... | | | | | 6 | 300 |
| Tongs..... | | | | | 21 | 136 |
| Grabs..... | | | | | 21 | 24 |
| Apparatus, shore fisheries: | | | | | | |
| Haul seines..... | | | | | 2 | 80 |
| Gill nets..... | 18 | 2,425 | 33 | 325 | 139 | 5,955 |
| Cast nets..... | 1 | 3 | | | 1 | 3 |
| Lines..... | | | | | | 13 |
| Other trawls..... | 2 | 100 | | | 73 | 3,700 |
| Tongs..... | 8 | 60 | | | 190 | 1,040 |
| Grabs..... | 28 | 35 | | | 210 | 224 |
| Shore and accessory property.. | | 17,200 | | 10 | | 420,779 |
| Cash capital..... | | 3,000 | | | | 72,400 |
| Total..... | | 27,138 | | 440 | | 769,998 |
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Bluefish..... | | | | | 5,000 | \$900 |
| Catfish..... | 2,675 | \$265 | | | 2,675 | 265 |
| Cero, or kingfish..... | | | | | 74 | 7 |
| Croaker..... | 390 | 20 | | | 5,000 | 255 |
| Flounders..... | 390 | 20 | | | 10,800 | 650 |
| Groupers..... | | | | | 27,758 | 1,019 |
| Grunts..... | | | | | 512 | 26 |
| Hickory shad..... | 7,887 | 1,350 | 4,925 | \$660 | 13,007 | 2,035 |
| King whiting..... | 568 | 56 | | | 27,390 | 1,408 |
| Menhaden..... | | | | | 29,484,600 | 88,453 |
| Mullet..... | 5,150 | 353 | | | 10,650 | 693 |
| Redfish, or red drum..... | 1,559 | 162 | | | 1,674 | 112 |
| Red snapper..... | | | | | 112,349 | 7,810 |
| Scup..... | | | | | 12,090 | 900 |
| Sea bass..... | | | | | 292,615 | 23,765 |
| Shad..... | 2,485 | 519 | 6,200 | 1,080 | 100,540 | 26,960 |
| Sharks..... | | | | | 1,289 | 30 |
| Sheepshead..... | 245 | 15 | | | 400 | 25 |
| Spot..... | | | | | 1,100 | 59 |
| Squeteague, or "sea trout"..... | 7,300 | 760 | | | 39,550 | 4,097 |
| Striped bass..... | | | | | 125 | 10 |
| Sturgeon..... | 34,150 | 4,700 | | | 39,150 | 4,700 |
| Tilefish..... | | | | | 35,000 | 2,400 |
| Yellowtail, or "silver perch"..... | | | | | 2,000 | 100 |
| Crabs, hard..... | | | | | 18,455 | 504 |
| Shrimp..... | 90,000 | 2,594 | | | 5,793,465 | 173,960 |
| Clams, hard..... | | | | | 2,120 | 75 |
| Oysters, market: | | | | | | |
| Public..... | 25,200 | 720 | | | 2,481,530 | 30,584 |
| Private..... | 97,800 | 10,060 | | | 6,628,292 | 43,029 |
| Octopus..... | | | | | 2,731 | 268 |
| Terrapin..... | | | | | 2,112 | 454 |
| Turtles..... | | | | | 11,250 | 100 |
| Total..... | 281,012 | 21,417 | 11,125 | 1,740 | 37,153,953 | 416,043 |

1 25,365 in number.

2 15 bushels.

3 68,790 bushels.

4 89,726 bushels.

FISHERIES BY APPARATUS.

The yield of all forms of apparatus in Georgia in 1918 amounted to 37,153,953 pounds, valued at \$416,043. In the value of their product, otter trawls, employed chiefly in the taking of shrimp, ranked first, with a catch of 5,838,115 pounds, valued at \$175,705. Exceeding all other forms of apparatus in quantity, but ranking second in the value of their catch, purse seines took 29,484,600 pounds of menhaden, valued at \$88,453. The yield of the gill-net fishery amounted to 203,332 pounds, valued at \$38,705, of which 100,540 pounds, valued at \$26,960, were shad. The catch with lines was 505,712 pounds, valued at \$38,224, the principal species taken by this apparatus in the order of their value being: Sea bass, red snapper, tilefish, and groupers. Oysters were taken with tongs to the amount of 486,444 pounds, or 69,492 bushels, valued at \$32,029, and with grabs to the amount of 468,678 pounds, or 66,954 bushels, valued at \$31,384. The combined take of oysters with these two forms of gear amounted to 136,446 bushels, valued at \$63,413.

Aside from purse seines, lines, and otter trawls used in the vessel fisheries, the only other forms of apparatus employed were dredges, tongs, and grabs, all of which were engaged in taking oysters.

The bulk of the catch in the shore fisheries was made with otter trawls, gill nets, tongs, and grabs, the remainder being taken by hand and with lines, seines, and cast nets.

The products of the vessel and shore or boat fisheries are shown in the appended tables.

YIELD OF VESSEL FISHERIES OF GEORGIA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES.

| Apparatus and species. | Camden. | | Chatham. | | Glynn. | | Total. | |
|--|------------|----------|----------|--------|---------|----------|------------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Purse seines: Menhaden..... | 29,484,600 | \$88,453 | | | | | 29,484,600 | \$88,453 |
| Lines: | | | | | | | | |
| Bluefish..... | | | 5,000 | \$600 | | | 5,000 | 900 |
| Cero, or kingfish..... | | | 71 | 7 | | | 71 | 7 |
| Flounders..... | | | 500 | 55 | | | 500 | 55 |
| Groupers..... | | | 27,758 | 1,019 | | | 27,758 | 1,019 |
| Grunts..... | | | 512 | 26 | | | 512 | 26 |
| Redfish, or red drum..... | | | 21 | 4 | | | 21 | 4 |
| Red snapper..... | | | 111,749 | 7,740 | | | 111,749 | 7,740 |
| Seup..... | | | 12,000 | 900 | | | 12,000 | 900 |
| Sea bass..... | | | 291,490 | 23,655 | | | 291,490 | 23,655 |
| Sharks..... | | | 1,289 | 30 | | | 1,289 | 30 |
| Squeteague, or "sea trout"..... | | | 2,500 | 185 | | | 2,500 | 185 |
| Tilefish..... | | | 35,000 | 2,400 | | | 35,000 | 2,400 |
| Octopus..... | | | 2,731 | 268 | | | 2,731 | 268 |
| Total..... | | | 490,627 | 37,189 | | | 490,627 | 37,189 |
| Otter trawls: Shrimp..... | 155,655 | 4,600 | | | 410,665 | \$11,800 | 566,320 | 16,400 |
| Dredges: Oysters, market, private..... | | | 116,900 | 9,100 | | | 116,900 | 9,100 |
| Tongs: Oysters, market— | | | | | | | | |
| Public..... | | | 30,900 | 2,100 | | | 30,900 | 2,100 |
| Private..... | | | 3,500 | 300 | 43,120 | 800 | 46,620 | 1,100 |
| Total..... | | | 43,400 | 2,400 | 43,120 | 800 | 86,520 | 3,200 |
| Grabs: Oysters, market— | | | | | | | | |
| Public..... | | | 37,275 | 1,875 | | | 37,275 | 1,875 |
| Private..... | | | 3,500 | 300 | 43,078 | 800 | 46,578 | 1,100 |
| Total..... | | | 40,775 | 2,175 | 43,078 | 800 | 83,853 | 2,975 |
| Grand total..... | 29,640,255 | 93,053 | 691,702 | 50,864 | 496,863 | 13,400 | 30,828,820 | 157,317 |

YIELD OF SHORE FISHERIES OF GEORGIA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY GILL NETS.

| Species. | Bryan. | | Camden. | | Chatham. | | Effingham. | | Glynn. | |
|---------------------------------|---------|---------|---------|----------|----------|--------|------------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Flounders..... | | | | | 100 | \$12 | | | 5,000 | \$325 |
| King whiting..... | | | | | 3,000 | 240 | | | | 325 |
| Mullet..... | | | | | | | | | 600 | 70 |
| Red snapper..... | | | | | | | | | 1,000 | 100 |
| Sea bass..... | 13,500 | \$3,262 | 61,250 | \$18,000 | 14,502 | 3,505 | 1,998 | \$483 | | |
| Shad..... | | | | | | | | | 500 | 24 |
| Spot..... | | | | | 1,200 | 200 | | | 25,000 | 2,800 |
| Squeteague, or "sea trout"..... | | | | | 2,030 | 419 | | | | |
| Terrapin..... | | | | | | | | | | |
| Total..... | 13,500 | 3,262 | 61,250 | 18,000 | 20,832 | 4,375 | 1,998 | 483 | 37,100 | 3,644 |

| Species. | Liberty. | | McIntosh. | | Wayne. | | Total. | |
|---------------------------------|----------|--------|-----------|--------|---------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Flounders..... | | | 150 | \$10 | | | 5,150 | \$335 |
| Hickory shad..... | 195 | \$25 | 7,887 | 1,350 | 4,925 | \$660 | 13,007 | 2,035 |
| King whiting..... | | | 30 | 2 | | | 5,130 | 339 |
| Mullet..... | | | 4,400 | 303 | | | 7,400 | 543 |
| Redfish, or red drum..... | | | 650 | 45 | | | 650 | 45 |
| Red snapper..... | | | | | | | 600 | 70 |
| Sea bass..... | | | | | | | 1,000 | 100 |
| Shad..... | 605 | 111 | 2,485 | 519 | 6,200 | 1,080 | 100,510 | 25,960 |
| Sheepshead..... | | | 75 | 5 | | | 75 | 5 |
| Spot..... | | | | | | | 500 | 24 |
| Squeteague, or "sea trout"..... | | | 1,900 | 130 | | | 28,100 | 3,130 |
| Sturgeon..... | | | 39,150 | 4,700 | | | 39,150 | 4,700 |
| Terrapin..... | | | | | | | 2,030 | 419 |
| Total..... | 800 | 136 | 56,727 | 7,064 | 11,125 | 1,710 | 203,332 | 38,705 |

BY SEINES, OTTER TRAWLS, CAST NETS, LINES, AND HAND.

| Apparatus and species. | Camden. | | Glynn. | | McIntosh. | | Total. | |
|------------------------------------|-----------|----------|-----------|---------|-----------|--------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Seines: | | | | | | | | |
| Croakers..... | | | 600 | \$35 | | | 600 | \$35 |
| King whiting..... | | | 1,200 | 72 | 300 | \$17 | 1,500 | 89 |
| Mullet..... | | | 2,500 | 100 | | | 2,500 | 100 |
| Redfish, or red drum..... | | | 100 | 6 | 300 | 17 | 400 | 23 |
| Spot..... | | | 600 | 35 | | | 600 | 35 |
| Squeteague, or "sea trout"..... | | | 1,200 | 72 | 4,400 | 500 | 5,600 | 572 |
| Crabs, hard..... | | | 120 | 4 | | | 120 | 4 |
| Shrimp..... | | | 100 | 25 | | | 100 | 25 |
| Total..... | | | 6,420 | 349 | 5,000 | 534 | 11,420 | 883 |
| Otter trawls: | | | | | | | | |
| Croakers..... | | | 5,000 | 200 | | | 5,000 | 200 |
| Flounders..... | | | 5,000 | 250 | | | 5,000 | 250 |
| King whiting..... | | | 20,000 | 1,000 | | | 20,000 | 1,000 |
| Squeteague, or "sea trout"..... | | | 1,500 | 90 | | | 1,500 | 90 |
| Yellowtail, or "silver perch"..... | | | 2,000 | 100 | | | 2,000 | 100 |
| Shrimp..... | 1,155,163 | \$34,446 | 4,001,882 | 120,525 | 90,000 | 2,594 | 5,227,045 | 157,565 |
| Turtles..... | | | 11,250 | 100 | | | 11,250 | 100 |
| Total..... | 1,155,163 | 34,446 | 4,006,632 | 122,265 | 90,000 | 2,594 | 5,271,795 | 159,365 |
| Cast nets: Mullet..... | | | | | 750 | 50 | 750 | 50 |
| Lines: | | | | | | | | |
| Hand lines— | | | | | | | | |
| Croakers..... | | | | | 300 | 20 | 300 | 20 |
| Flounders..... | | | | | 150 | 10 | 150 | 10 |
| King whiting..... | | | | | 600 | 40 | 600 | 40 |
| Redfish, or red drum..... | | | | | 600 | 40 | 600 | 40 |
| Sea bass..... | 125 | 10 | | | | | 125 | 10 |
| Sheepshead..... | 175 | 10 | | | 150 | 10 | 325 | 20 |
| Squeteague, or "sea trout"..... | | | | | 1,000 | 70 | 1,850 | 120 |
| Striped bass..... | 850 | 50 | | | | | 125 | 10 |
| Total..... | 1,275 | 80 | | | 2,800 | 190 | 4,075 | 270 |
| Set lines—catfish..... | | | | | 2,675 | 265 | 2,675 | 265 |
| Trot lines—crabs, hard..... | | | 8,335 | 500 | | | 8,335 | 500 |
| Total, by lines..... | 1,275 | 80 | 8,335 | 500 | 5,475 | 455 | 15,085 | 1,035 |
| Hand: | | | | | | | | |
| Terrapin..... | | | 82 | 35 | | | 82 | 35 |
| Clams, hard..... | | | 120 | 75 | | | 120 | 75 |
| Oyster, market, public..... | 37,800 | 1,400 | | | | | 37,800 | 1,400 |
| Total..... | 37,800 | 1,400 | 202 | 110 | | | 38,002 | 1,510 |

YIELD OF SHORE FISHERIES OF GEORGIA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY TONGS AND GRABS.

| Apparatus and species. | Chatham. | | Glynn. | | Liberty. | | McIntosh. | | Total. | |
|-------------------------|----------|----------|---------|--------|----------|---------|-----------|--------|---------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Tongs: Oysters, market: | | | | | | | | | | |
| Public..... | 167,881 | \$12,195 | 2,800 | \$200 | ..... | ..... | 12,600 | \$360 | 183,281 | \$12,755 |
| Private..... | 67,536 | 7,174 | 16,156 | 300 | 84,021 | \$3,600 | 48,930 | 5,000 | 216,643 | 16,074 |
| Total..... | 235,417 | 19,369 | 18,956 | 500 | 84,021 | 3,600 | 61,530 | 5,360 | 399,924 | 28,829 |
| Grabs: Oysters, market: | | | | | | | | | | |
| Public..... | 167,874 | 12,194 | 2,800 | 200 | ..... | ..... | 12,600 | 360 | 183,274 | 12,754 |
| Private..... | 69,643 | 7,414 | 12,978 | 241 | 70,000 | 3,000 | 48,930 | 5,000 | 201,551 | 15,655 |
| Total..... | 237,517 | 19,608 | 15,778 | 441 | 70,000 | 3,000 | 61,530 | 5,360 | 384,825 | 28,409 |

INDUSTRIES.

Wholesale trade.—In 1918 there were 18 establishments, valued at \$237,575, in operation. These used working cash capital to the amount of \$33,000 and gave employment to 223 persons, to whom \$66,900 were paid in wages.

Canning industry.—There were 10 establishments, valued at \$265,444, engaged in canning oysters, shrimp, etc., in preparing cooked shrimp for market, and in crushing oyster shells. These used cash capital to the amount of \$30,300 and gave employment to 634 persons, to whom \$129,075 were paid in wages. The products included canned oysters to the value of \$93,208; canned shrimp to the value of \$355,548; 40 cases of canned flounders, valued at \$200; 464.983 pounds of cooked shrimp, valued at \$103,889; poultry grit from ground oyster shells, 127 tons, valued at \$1,525; and lime from oyster shells, 18 tons, valued at \$99.

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS OF GEORGIA IN 1918.

| Item. | Number. | Value. | Item. | Number. | Value. |
|--------------------------|---------------------|-----------|---|----------------------|-----------|
| Establishments..... | 10 | \$265,444 | PRODUCTS—continued. | | |
| Cash capital..... | | 30,300 | Shrimp, canned: | | |
| Persons engaged..... | 634 | | No. 1 cans.....cases.. | ² 55,706 | \$295,567 |
| Wages paid..... | | 129,075 | No. 1½ cans.....do.... | ¹ 10,740 | 59,981 |
| PRODUCTS. | | | Total..... | | 355,548 |
| Oysters, canned: | | | Flounders, canned: 10-ounce cans.....cases..... | ² 40 | 200 |
| 4-ounce cans.....cases.. | ¹ 500 | 1,300 | Shrimp, cooked: | | |
| 5-ounce cans.....do.... | ¹ 14,799 | 41,837 | Meat.....pounds.. | 214,684 | 64,865 |
| Do.....do..... | ² 6,329 | 35,576 | Headless, cooked...do.... | 198,945 | 33,582 |
| 6-ounce cans.....do.... | ² 50 | 400 | Whole, cooked.....do.... | 51,354 | 5,442 |
| 10-ounce cans.....do.... | ¹ 2,364 | 13,645 | Oyster shells: | | |
| 12-ounce cans.....do.... | ¹ 50 | 400 | Crushed, poultry grit, pounds..... | ³ 254,000 | 1,525 |
| Total..... | | 93,208 | Lime.....tons..... | 18 | 99 |

¹ Two dozen cans per case.² Four dozen cans per case.³ Includes oyster shells crushed in South Carolina.

FISHERIES OF EAST COAST OF FLORIDA.

The statistics here presented are for the eastern coast of Florida and, among the South Atlantic States, were surpassed only by North Carolina. The number of persons employed was 3,330, of whom 395 were on fishing and transporting vessels, 2,104 in the shore or boat fisheries, and 831 in the wholesale fishery trade, the menhaden industry, and the oyster and shrimp canning industry. Compared with 1902, there has been an increase in the persons employed of 632.

The investment amounted to \$2,210,679, which includes 30 fishing and transporting vessels, valued at \$409,900, with a net tonnage of 814 tons and outfits valued at \$75,137; 839 power boats, valued at \$459,650; 607 sail, row, and other boats, valued at \$20,180; fishing apparatus employed on vessels and boats, valued at \$235,492; shore and accessory property to the value of \$858,720; and working cash capital amounting to \$151,600. Compared with 1902, the increase in the investment amounts to \$1,855,844.

The products of eastern Florida amounted to 81,211,488 pounds, valued at \$1,746,175, an increase of 61,627,223 pounds, or 314.67 per cent, in the quantity and \$1,268,307, or 265.41 per cent, in the value as compared with 1902.

The 10 leading products arranged in order of value follow: Mullet, 10,417,889 pounds, valued at \$397,147; shrimp, 8,867,918 pounds, valued at \$266,651; Spanish mackerel, 3,061,965 pounds, valued at \$218,085; menhaden, 48,362,600 pounds, valued at \$210,175; cero and kingfish, 2,271,792 pounds, valued at \$147,608; squeteague or "sea trout," 1,645,223 pounds, valued at \$142,091; shad, 963,606 pounds, valued at \$135,844; bluefish, 561,301 pounds, valued at \$54,715; red and black drum, 900,091 pounds, valued at \$24,638; and oysters, 458,990 pounds, or 65,570 bushels, valued at \$20,128.

Compared with 1902, the increase in the catch of bluefish amounts to 481,801 pounds, or 606.03 per cent; of red and black drum, to 765,206, or 567.30 per cent; of mullet, to 3,076,973 pounds, or 41.91 per cent; of Spanish mackerel, to 2,402,877 pounds, or 364.57 per cent; of squeteague, to 746,660 pounds, or 83.09 per cent; and of shrimp, to 5,855,064 pounds, or 194.33 per cent. There has been a decrease in the catch of shad as compared with 1902, amounting to 855,825 pounds, or 47.04 per cent; and of oysters, of 1,704,493 pounds, or 243,499 bushels, or 78.78 per cent. No cero, kingfish (not king whiting), or menhaden were included in the returns for 1902.

A comparison of the fisheries of the east and west coast of Florida in 1918 is given on pages 116, 117.

FISHERIES BY COUNTIES.

The statistics of the number of persons engaged, investment, and products of the fisheries of the eastern coast of Florida in 1918, by counties, are given in the table following.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST
COAST OF FLORIDA IN 1918, BY COUNTIES.

| Item. | Brevard. | | Broward. | | Dade. | | Duval. | | Lake. | |
|--|-----------|---------|----------|--------|-----------|----------|------------|-----------|---------|--------|
| | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| PERSONS ENGAGED. | | | | | | | | | | |
| On vessels fishing. | | | | | 114 | | 214 | | | |
| On vessels trans- porting. | | | | | 9 | | | | | |
| In shore fisheries. | 228 | | 2 | | 229 | | 167 | | 5 | |
| Shoresmen. | | | | | 48 | | 163 | | | |
| Total. | 228 | | 2 | | 400 | | 544 | | 5 | |
| INVESTMENT. | | | | | | | | | | |
| Vessels fishing: | | | | | | | | | | |
| Gasoline. | | | | | 12 | \$89,100 | 9 | \$258,500 | | |
| Tonnage. | | | | | 202 | | 467 | | | |
| Outfit. | | | | | | 4,143 | | 48,997 | | |
| Vessels transport- ing: Gasoline. | | | | | 5 | 2,300 | | | | |
| Tonnage. | | | | | 36 | | | | | |
| Outfit. | | | | | | 2,250 | | | | |
| Boats: | | | | | | | | | | |
| Sail, row etc. | 216 | \$5,820 | 1 | \$40 | | | 20 | 550 | 2 | \$60 |
| Power. | 98 | 29,100 | 1 | 250 | 124 | 59,300 | 73 | 20,250 | 1 | 250 |
| Apparatus, vessel fisheries: Purse seines. | | | | | 12 | 22,400 | 9 | 22,500 | | |
| Apparatus, shore fisheries: | | | | | | | | | | |
| Haul seines. | | | 1 | 175 | | | 8 | 280 | 1 | 200 |
| Gill nets. | 182 | 23,800 | | | 43 | 6,450 | 92 | 12,800 | | |
| Cast nets. | | | | | | | 6 | 30 | | |
| Dip nets. | | | | | 3 | 3 | | | | |
| Lines. | | 40 | | 5 | | 920 | | 190 | | |
| Traps. | | | | | | | 20 | 50 | | |
| Gaffs. | | | | | 3 | 3 | | | | |
| Tongs. | | | | | | | 10 | 70 | | |
| Shore and access- ory property. | | 19,000 | | 50 | | 104,806 | | 583,835 | | 500 |
| Cash capital. | | | | | | 18,000 | | 55,000 | | |
| Total. | | 80,700 | | 520 | | 329,675 | | 1,003,052 | | 1,010 |
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives. | | | | | | | | | 30,000 | \$450 |
| Amberfish. | | | 150 | \$12 | 200 | \$8 | | | | |
| Angelfish. | | | | | 175 | 7 | | | | |
| Barracuda. | | | 150 | 12 | 200 | 8 | | | | |
| Black drum. | 36,500 | \$1,095 | 160 | 8 | | | 32,400 | \$1,020 | | |
| Bluefish. | | | 300 | 60 | 23,864 | 1,866 | 1,600 | 165 | | |
| Blue runner or hardtail. | | | | | 2,500 | 82 | | | | |
| Bonito. | | | 100 | 10 | 50 | 3 | | | | |
| Butterfish. | | | | | 4,200 | 170 | | | | |
| Cero and kingfish. | | | 300 | 45 | 973,331 | 68,133 | | | | |
| Cow fish and "shefish." | | | | | 50 | 2 | | | | |
| Crevalle. | 3,300 | 132 | 800 | 80 | 800 | 26 | | | | |
| Flounders. | 1,210 | 48 | | | | | 400 | 40 | | |
| Groupers. | | | 200 | 20 | 41,978 | 2,518 | | | | |
| Grunts. | | | 400 | 40 | 10,650 | 426 | | | | |
| Hogfish. | | | | | 150 | 6 | | | | |
| King whiting. | 13,909 | 1,132 | | | | | 32,600 | 2,240 | | |
| Leather jacket or "turbot" | | | | | 200 | 8 | | | | |
| Menhaden. | | | | | | | 42,635,400 | 181,201 | | |
| Moonfish. | | | 100 | 8 | 540 | 16 | | | | |
| Mullet. | 4,292,600 | 171,704 | 500 | 50 | 2,651,085 | 90,395 | 78,000 | 4,740 | | |
| Permit. | | | 50 | 5 | | | | | | |
| Pigfish. | 2,000 | 64 | | | 100 | 4 | | | | |
| Pinfish or sailor's choice. | 43,150 | 1,386 | 200 | 20 | 200 | 10 | | | | |
| Pompano. | 100 | 15 | 30 | 6 | 446 | 68 | 240 | 36 | | |
| Porgies. | | | | | 5,000 | 300 | | | | |
| Porkfish. | | | | | 350 | 17 | | | | |
| Redfish or red drum. | 31,400 | 1,256 | 100 | 12 | | | 25,400 | 1,680 | | |
| Sea bass. | | | | | 100 | 8 | 20,000 | 1,600 | | |
| Sergeantfish or snook. | 430 | 15 | 350 | 28 | | | | | | |
| Shad. | | | | | | | 265,608 | 36,855 | 4,850 | 678 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY COUNTIES—Continued.

| Item. | Brevard. | | Broward. | | Dade. | | Duval. | | Lake. | |
|------------------------------------|-----------|---------|----------|--------|-----------|---------|------------|---------|---------|---------|
| PRODUCTS—CON. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Sharks..... | | | | | | | 50,000 | \$250 | | |
| Sheepshead..... | 11,945 | \$478 | 50 | \$5 | 100 | \$6 | 14,000 | \$40 | | |
| Snapper: | | | | | | | | | | |
| Mangrove..... | 200 | 8 | 600 | 60 | 2,700 | 135 | | | | |
| Mutton..... | 1,400 | 54 | 765 | 76 | 7,500 | 300 | | | | |
| Red..... | | | | | | | 10,200 | 1,920 | | |
| Spanish mackerel..... | | | | | 870,415 | 50,800 | | | | |
| Spot..... | 20,500 | 675 | | | | | 1,200 | 96 | | |
| Squeteague or "sea trout"..... | 591,482 | 50,291 | | | 1,000 | 80 | 88,000 | 7,200 | | |
| Yellowtail or "silver perch"..... | | | | | 450 | 18 | | | | |
| Crabs, hard..... | | | | | | | 52,000 | 1,800 | | |
| Sea crawfish or spiny lobster..... | | | | | 21,408 | 1,070 | | | | |
| Oysters, market, public..... | | | | | | | 31,500 | 1,800 | | |
| Turtles..... | | | | | 6,000 | 260 | | | | |
| Total..... | 3,630,117 | 228,350 | 5,249 | 554 | 4,625,742 | 225,856 | 43,347,948 | 243,488 | 31,850 | \$1,128 |

| Item. | Nassau. | | Palm Beach. | | Putnam. | | Seminole. | |
|-----------------------------------|---------|----------|-------------|---------|---------|---------|-----------|---------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 52 | | | | | | | |
| In shore fisheries..... | 319 | | 351 | | 142 | | 59 | |
| Shoresmen..... | 541 | | 42 | | | | | |
| Total..... | 912 | | 393 | | 142 | | 59 | |
| INVESTMENT. | | | | | | | | |
| Vessel fishing: Gasoline..... | 2 | \$40,000 | | | | | | |
| Tonnage..... | 36 | | | | | | | |
| Outfit..... | | \$,117 | | | | | | |
| Boats: | | | | | | | | |
| Sail, row, etc..... | 42 | 2,380 | 53 | \$4,505 | 88 | \$2,200 | 49 | \$1,225 |
| Power..... | 132 | 154,700 | 229 | 140,500 | 18 | 5,450 | 12 | 2,450 |
| Apparatus, vessel fisheries: | | | | | | | | |
| Purse seines..... | 4 | 8,000 | | | | | | |
| Apparatus, shore fisheries: | | | | | | | | |
| Purse seines..... | | | 2 | 3,000 | | | | |
| Haul seines..... | | | 24 | 18,900 | 15 | 3,200 | 28 | 1,575 |
| Gill nets..... | 16 | 1,050 | 181 | 25,975 | 36 | 4,000 | | |
| Lines..... | | | | 1,570 | | | | |
| Otter trawls..... | 259 | 16,250 | | | | | | |
| Tongs..... | | | 1 | 7 | | | | |
| Shore and accessory property..... | | 200 | | 92,005 | | 3,900 | | 3,000 |
| Cash capital..... | | 41,000 | | 18,100 | | | | |
| Total..... | | 262,027 | | 293,652 | | 18,750 | | 8,250 |

| Item. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
|------------------------------|---------|--------|-----------|---------|---------|---------|---------|--------|
| Albacore..... | | | | | 334,542 | \$5,018 | | |
| Amberfish..... | | | 11,350 | \$370 | | | | |
| Anguilla..... | | | 1,170 | 37 | | | | |
| Barracuda..... | | | 2,515 | 76 | | | | |
| Black drum..... | | | 25,950 | 508 | | | | |
| Bluefish..... | | | 362,330 | 36,532 | | | | |
| Blue runner or hardtail..... | | | 47,000 | 1,447 | | | | |
| Bonito..... | | | 7,811 | 236 | | | | |
| Catfish..... | | | 1,000 | 32 | | | | |
| Cero and kingfish..... | | | 1,298,161 | 79,439 | | | | |
| Creville..... | | | 61,910 | 2,021 | | | | |
| Croaker..... | | | 34,388 | 1,031 | | | | |
| Flounder..... | | | 430 | 17 | | | | |
| Grunt..... | | | 32,005 | 1,084 | | | | |
| Grunt..... | | | 18,100 | 595 | | | | |
| Hogfish..... | | | 100 | 5 | | | | |
| Jewfish..... | | | 7,117 | 222 | | | | |
| Kingfish..... | | | 100,000 | \$2,000 | | | | |
| Lard fish..... | | | 1,250 | 43 | | | | |
| Lard fish..... | | | 170 | 5 | | | | |
| Mummichog..... | | | 5,660,000 | 28,300 | | | | |
| Mummichog..... | | | 7,230 | 218 | | | | |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY COUNTIES—Continued.

| Item. | Nassau. | | Palm Beach. | | Putnam. | | Seminole. | |
|------------------------------------|------------|----------|-------------|----------|---------|----------|-----------|----------|
| PRODUCTS—continued. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Mullet..... | | | 1,016,734 | \$37,466 | | | | |
| Parrotfish..... | | | 3,500 | 70 | | | | |
| Permit..... | | | 6,465 | 213 | | | | |
| Pigfish..... | | | 4,932 | 148 | | | | |
| Pintfish or sailer's choice..... | | | 34,135 | 1,031 | | | | |
| Pompano..... | | | 60,029 | 9,568 | | | | |
| Porgies..... | | | 950 | 28 | | | | |
| Porkfish..... | | | 1,360 | 40 | | | | |
| Redfish or red drum..... | | | 32,355 | 1,167 | | | | |
| Sea bass..... | | | 19,821 | 1,021 | | | | |
| Sea gar or needlefish..... | | | 100 | 5 | | | | |
| Sergeantfish or snook..... | | | 81,074 | 2,604 | | | | |
| Shad..... | 61,250 | \$18,000 | | | 456,471 | \$56,786 | 102,164 | \$13,277 |
| Sharks..... | | | 13,350 | 272 | | | | |
| Sheepshead..... | | | 16,686 | 608 | | | | |
| Snapper: | | | | | | | | |
| Mangrove..... | | | 16,195 | 666 | | | | |
| Mutton..... | | | 93,385 | 2,994 | | | | |
| Red..... | | | 1,000 | 80 | | | | |
| Spanish mackerel..... | | | 1,493,319 | 102,290 | | | | |
| Spot..... | | | 31,040 | 939 | | | | |
| Squeteague or "sea trout"..... | | | 135,835 | 12,567 | | | | |
| Yellowtail or "silver perch"..... | | | 20,230 | 607 | | | | |
| Shrimp..... | 8,806,568 | 264,197 | | | | | | |
| Sea crawfish or spiny lobster..... | | | 2,095 | 104 | | | | |
| Oysters, market: | | | | | | | | |
| Public..... | 90,293 | 3,315 | 2,100 | 195 | | | | |
| Private..... | 135,065 | 3,994 | 10,500 | 1,000 | | | | |
| Turtles..... | | | 250 | 12 | | | | |
| Cowh meat..... | | | 7,000 | 700 | | | | |
| Total..... | 14,853,176 | 319,806 | 5,094,853 | 301,372 | 790,997 | 61,804 | 102,161 | 13,277 |

| Item. | St. John. | | St. Lucie. | | Volusia. | | Total. | |
|-------------------------------------|-----------|--------|------------|----------|----------|---------|---------|-----------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | | | 6 | | | | 380 | |
| On vessels transporting..... | | | | | | | 15 | |
| In shore fisheries..... | 34 | | 280 | | 88 | | 2,101 | |
| Shoresmen..... | | | 37 | | | | 831 | |
| Total..... | 34 | | 323 | | 88 | | 3,330 | |
| INVESTMENT. | | | | | | | | |
| Vessels fishing: Gasoline..... | | | | | | | 23 | \$377,600 |
| Tonnage..... | | | | | | | 725 | |
| Outfit..... | | | | | | | | 71,287 |
| Vessels transporting: Gasoline..... | | | 2 | \$20,000 | | | 7 | 32,300 |
| Tonnage..... | | | 53 | | | | 89 | |
| Outfit..... | | | | 1,600 | | | | 3,850 |
| Boats: | | | | | | | | |
| Sail, row, etc..... | 15 | \$375 | 52 | 2,185 | 66 | \$1,840 | 607 | 20,180 |
| Power..... | 9 | 2,550 | 120 | 49,250 | 22 | 5,600 | 839 | 459,650 |
| Apparatus, vessel fisheries: | | | | | | | | |
| Purse seines..... | | | | | | | 25 | 52,000 |
| Apparatus, shore fisheries: | | | | | | | | |
| Purse seines..... | | | | | | | 2 | 3,000 |
| Haul seines..... | 5 | 750 | 26 | 32,100 | 8 | 850 | 115 | 58,030 |
| Gill nets..... | 5 | 500 | 115 | 17,400 | 45 | 6,750 | 715 | 101,725 |
| Cast nets..... | 10 | 50 | | | | | 16 | 80 |
| Dip nets..... | | | | | | | 3 | |
| Lines..... | | 140 | | | | 100 | | 2,965 |
| Otter trawls..... | 5 | 250 | | | | | 255 | 16,500 |
| Traps..... | | | | | | | 20 | 50 |
| Spears..... | 12 | 12 | | | | | 12 | 12 |
| Gaffs..... | | | | | | | 3 | 3 |
| Tongs..... | 5 | 30 | 2 | 14 | 14 | 98 | 32 | 219 |
| Hooks..... | 5 | 5 | | | | | 5 | 5 |
| Shore and accessory property..... | | 500 | | 45,031 | | 5,500 | | 858,720 |
| Cash capital..... | | | | 19,500 | | | | 151,600 |
| Total..... | | 5,062 | | 187,083 | | 20,738 | | 2,210,679 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST
COAST OF FLORIDA IN 1918, BY COUNTIES—Continued.

| Item. | St. John. | | St. Lucie. | | Volusia. | | Total. | |
|------------------------------------|-----------|--------|------------|---------|-----------|---------|------------|-----------|
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives..... | | | | | 327,739 | \$4,905 | 692,265 | \$10,373 |
| Amberfish..... | | | | | | | 11,686 | 390 |
| Angelfish..... | | | 1,570 | \$47 | | | 2,915 | 91 |
| Barracuda..... | | | 50 | 1 | | | 2,915 | 97 |
| Black drum..... | 16,930 | \$526 | 407,192 | 8,408 | 14,200 | 618 | 531,332 | 12,178 |
| Bluefish..... | 900 | 92 | 171,648 | 15,365 | 650 | 65 | 561,301 | 54,715 |
| Blue runner or hardtail..... | | | 650 | 13 | | | 50,750 | 1,542 |
| Bonito..... | 159 | 9 | | | | | 8,141 | 358 |
| Butterfish..... | | | | | | | 4,200 | 170 |
| Catfish..... | | | 12,300 | 246 | | | 13,900 | 278 |
| Cero and kingfish..... | | | | | | | 2,271,792 | 147,608 |
| Cowfish and "shellfish"..... | | | | | | | 50 | 2 |
| Crevaille..... | | | 254,220 | 7,574 | | | 321,030 | 9,833 |
| Croaker..... | 2,150 | 84 | 87,740 | 2,332 | | | 124,278 | 3,447 |
| Flounders..... | 7,670 | 460 | 2,980 | 110 | 800 | 32 | 13,490 | 737 |
| Grouper..... | | | | | | | 71,783 | 3,622 |
| Grunts..... | 150 | 9 | 84,019 | 2,559 | | | 113,679 | 3,629 |
| Hogfish..... | | | | | | | 250 | 11 |
| Jewfish..... | 220 | 9 | 5,150 | 134 | | | 12,487 | 365 |
| King whiting..... | 3,150 | 176 | 82,797 | 4,855 | 51,950 | 4,671 | 297,008 | 15,604 |
| Ladyfish..... | | | | | | | 1,280 | 13 |
| Leather jacket or "turbot"..... | | | | | | | 370 | 13 |
| Menhaden..... | | | 10,200 | 104 | | | 48,362,600 | 210,175 |
| Moonfish..... | | | 100 | 3 | | | 7,970 | 245 |
| Mullet..... | 12,110 | 529 | 1,423,870 | 54,535 | 942,960 | 87,728 | 10,417,889 | 397,147 |
| Parrotfish..... | | | | | | | 3,500 | 70 |
| Permit..... | 145 | 5 | 460 | 11 | 200 | 10 | 7,290 | 244 |
| Pigfish..... | 300 | 12 | 6,630 | 199 | 800 | 24 | 14,762 | 451 |
| Pinfish or sailor's choice..... | 1,180 | 47 | 359,270 | 10,404 | 4,400 | 152 | 442,535 | 13,033 |
| Pompano..... | 825 | 124 | 67,749 | 9,672 | 4,000 | 400 | 133,419 | 19,889 |
| Porgies..... | | | | | | | 5,950 | 328 |
| Porkfish..... | | | | | | | 1,710 | 57 |
| Redfish or red drum..... | 9,230 | 431 | 259,874 | 7,482 | 9,400 | 432 | 398,759 | 12,460 |
| Sea bass..... | 1,440 | 70 | | | | | 41,331 | 2,669 |
| Sea gar or needlefish..... | | | | | | | 100 | 5 |
| Sergeantfish or snook..... | | | 232,920 | 5,982 | | | 314,774 | 8,629 |
| Shad..... | | | | | 73,266 | 10,248 | 963,695 | 135,344 |
| Sharks..... | | | 425 | 4 | | | 63,775 | 326 |
| Sheepshead..... | 665 | 29 | 60,557 | 2,125 | 500 | 24 | 104,903 | 4,145 |
| Snapper: | | | | | | | | |
| Mangrove..... | | | 3,491 | 106 | | | 23,186 | 975 |
| Mutton..... | | | 138,693 | 3,981 | | | 244,078 | 7,399 |
| Red..... | | | | | | | 20,200 | 2,000 |
| Spanish mackerel..... | 1,510 | 151 | 696,721 | 55,838 | | | 3,051,365 | 218,085 |
| Spot..... | 3,390 | 144 | 341,140 | 9,938 | 5,500 | 266 | 394,030 | 11,998 |
| Squeteague or "sea trout"..... | 25,372 | 1,947 | 667,534 | 57,746 | 136,000 | 12,260 | 1,645,223 | 142,091 |
| Yellowtail or "silver perch"..... | | | 23,290 | 654 | | | 43,970 | 1,279 |
| Shrimp..... | 61,350 | 2,154 | | | | | 8,897,918 | 263,654 |
| Crabs, hard..... | | | | | | | 152,000 | 1,800 |
| Sea crawfish or spiny lobster..... | | | | | | | 23,906 | 1,174 |
| Clams, hard..... | 2,400 | 600 | | | | | 2,400 | 600 |
| Oysters, market: | | | | | | | | |
| Public..... | 31,500 | 2,250 | 4,900 | 455 | 153,132 | 7,119 | 2,313,425 | 15,134 |
| Private..... | | | | | | | 145,565 | 4,994 |
| Turtles..... | | | 600 | 30 | | | 6,850 | 402 |
| Conch meat..... | | | | | | | 7,000 | 700 |
| Total..... | 182,707 | 10,158 | 5,398,110 | 261,513 | 1,725,557 | 78,874 | 81,211,488 | 1,746,175 |

¹ 156,000 in number.² 300 bushels.³ 44,775 bushels.⁴ 20,795 bushels.

FISHERIES BY APPARATUS.

Gill nets were the most productive form of apparatus employed in the fisheries of the east coast of Florida in 1918, the catch amounting to 11,636,930 pounds, valued at \$671,599. The principal species taken with this form of apparatus were: Mullet, 6,882,403 pounds, valued at \$275,395; Spanish mackerel, 2,301,590 pounds, valued at \$166,592; shad, 591,719 pounds, valued at \$87,789; squeteague or "sea trout," 1,039,347 pounds, valued at \$86,549; and bluefish, 374,340 pounds, valued at \$36,156. Purse seines, taking mostly menhaden, mullet, and Spanish mackerel, yielded 51,446,435 pounds,

valued at \$332,812. Other leading forms of apparatus, in the order of their importance, based on the value of their catch, were: Otter trawls with 8,967,918 pounds, principally shrimp, valued at \$268,651; haul seines with 5,699,060 pounds, valued at \$254,635; and lines with 2,914,917 pounds, valued at \$192,880.

The total yield of all forms of apparatus employed in the fisheries of the east coast of Florida amounted to 81,211,488 pounds, valued at \$1,746,175, of which 63.04 per cent of the quantity and 18.63 per cent of the value are credited to purse seines operated in the vessel fisheries, the remainder being credited to the various forms of apparatus employed in the shore fisheries.

The products of the vessel and shore fisheries of the east coast of Florida in 1918 are shown in the following tables, by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF EAST COAST OF FLORIDA IN 1918, BY PURSE SEINES, COUNTIES, AND SPECIES.

| Species. | Dade. | | Duval. | | Nassau. | | Total. | |
|------------------------------|-----------|---------|------------|-----------|-----------|----------|------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Bluefish..... | 23,564 | \$1,836 | | | | | 23,564 | \$1,836 |
| Bluerunner or hard-tail..... | 900 | 34 | | | | | 900 | 34 |
| Butterfish..... | 4,200 | 170 | | | | | 4,200 | 170 |
| Menhaden..... | | | 42,635,400 | \$181,201 | 5,660,000 | \$28,300 | 48,295,400 | 209,501 |
| Mullet..... | 2,242,485 | 74,051 | | | | | 2,242,485 | 74,051 |
| Pompano..... | 86 | 14 | | | | | 86 | 14 |
| Sharks..... | | | 50,000 | 250 | | | 50,000 | 250 |
| Spanish mackerel..... | 579,800 | 39,456 | | | | | 579,800 | 39,456 |
| Total..... | 2,851,035 | 115,561 | 42,685,400 | 181,451 | 5,660,000 | 28,300 | 51,196,435 | 325,312 |

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES.

| Species. | Broward. | | Duval. | | Lake. | | Palm Beach. | | Putnam. | |
|-----------------------------------|----------|--------|---------|--------|---------|--------|-------------|--------|---------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives..... | | | | | 30,000 | \$450 | | | 334,526 | \$5,018 |
| Angelfish..... | | | | | | | 400 | \$12 | | |
| Barracuda..... | | | | | | | 100 | 3 | | |
| Black drum..... | 160 | \$8 | 2,400 | \$120 | | | 21,500 | 430 | | |
| Bluefish..... | 300 | 60 | 100 | 15 | | | 64,340 | 6,834 | | |
| Blue runner or hardtail..... | | | | | | | 25,175 | 775 | | |
| Bonito..... | | | | | | | 2,190 | 66 | | |
| Catfish..... | | | | | | | 1,600 | 32 | | |
| Cero or kingfish..... | | | | | | | 18,000 | 1,080 | | |
| Crevaille..... | 800 | 80 | | | | | 43,830 | 1,465 | | |
| Croaker..... | | | | | | | 21,850 | 655 | | |
| Flounders..... | | | 400 | 40 | | | 230 | 7 | | |
| Grunts..... | 200 | 20 | | | | | 7,390 | 261 | | |
| Hogfish..... | | | | | | | 100 | 5 | | |
| Jewfish..... | | | | | | | 1,450 | 43 | | |
| King whiting..... | | | 8,000 | 800 | | | 7,936 | 291 | | |
| Ladyfish..... | | | | | | | 1,280 | 13 | | |
| Menhaden..... | | | | | | | 57,000 | 570 | | |
| Moonfish..... | 100 | 8 | | | | | 1,475 | 46 | | |
| Mullet..... | 500 | 50 | 16,000 | 1,280 | | | 1,727,891 | 26,368 | | |
| Parrotfish..... | | | | | | | 3,500 | 70 | | |
| Permit..... | 50 | 5 | | | | | 4,130 | 142 | | |
| Pigfish..... | | | | | | | 3,800 | 114 | | |
| Pinfish or "sailor's choice"..... | 200 | 20 | | | | | 31,310 | 949 | | |
| Pompano..... | 30 | 6 | 240 | 36 | | | 41,427 | 6,604 | | |
| Porkfish..... | | | | | | | 100 | 3 | | |
| Redfish or red drum..... | | | 2,400 | 240 | | | 21,285 | 682 | | |

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SEINES—Continued.

| Species. | Broward. | | Duval. | | Lake. | | Palm Beach. | | Putnam. | |
|--------------------------------|----------|--------|---------|--------|---------|--------|-------------|--------|---------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Sea gar or needlefish. | | | | | | | 100 | \$5 | | |
| Sergeantfish or snook. | 150 | \$12 | | | | | 59,376 | 1,871 | | |
| Shad. | | | | | 4,859 | \$678 | | | 191,610 | \$23,852 |
| Sharks. | | | | | | | 5,100 | 102 | | |
| Sheepshead. | | | | | | | 9,715 | 298 | | |
| Snapper: | | | | | | | | | | |
| Mangrove. | 300 | 30 | | | | | 1,920 | 59 | | |
| Mutton. | 600 | 60 | | | | | 47,680 | 1,430 | | |
| Spanish mackerel. | | | | | | | 166,122 | 10,683 | | |
| Spot. | | | 1,260 | \$96 | | | 22,800 | 692 | | |
| Squeteague or "sea trout". | | | 8,000 | 800 | | | 29,761 | 2,530 | | |
| Yellowtail or "silver perch". | | | | | | | 19,020 | 571 | | |
| Sea crawfish or spiny lobster. | | | | | | | 652 | 33 | | |
| Turtles. | | | | | | | 250 | 12 | | |
| Total. | 3,390 | 359 | 38,740 | 3,427 | 34,850 | 1,128 | 1,471,785 | 65,806 | 526,136 | 28,870 |

| Species. | Seminole. | | St. Lucie. | | St. John. | | Volusia. | | Total. | |
|--------------------------------|-----------|----------|------------|---------|-----------|--------|----------|---------|-----------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alwives. | | | | | | | 327,739 | \$4,905 | 692,265 | \$10,373 |
| Anchovy. | | | 1,470 | \$44 | | | | | 1,870 | 56 |
| Barramunda. | | | 50 | 1 | | | | | 150 | 4 |
| Black drum. | | | 406,292 | 8,388 | 7,120 | \$214 | 9,600 | 480 | 447,072 | 9,640 |
| Bluefish. | | | 46,300 | 4,029 | 150 | 15 | 670 | 65 | 112,159 | 11,618 |
| Blue runner or hardtail. | | | 650 | 13 | | | | | 25,825 | 788 |
| Bonito. | | | | | | | | | 2,190 | 66 |
| Catfish. | | | 12,300 | 216 | | | | | 13,900 | 278 |
| Cero or kingfish. | | | | | | | | | 18,000 | 1,080 |
| Crovalle. | | | 250,300 | 7,437 | | | | | 294,930 | 9,002 |
| Croaker. | | | 87,740 | 2,332 | 1,250 | 50 | | | 110,840 | 3,037 |
| Flounders. | | | 2,980 | 110 | | | | | 3,610 | 187 |
| Grunts. | | | 78,888 | 2,475 | | | | | 86,479 | 2,641 |
| Hogfish. | | | | | | | | | 100 | 5 |
| Jewfish. | | | 5,150 | 134 | | | | | 6,600 | 177 |
| King whiting. | | | 78,460 | 4,480 | 1,400 | 111 | 51,390 | 4,617 | 147,446 | 10,269 |
| Ladyfish. | | | | | | | | | 1,280 | 13 |
| Menhaden. | | | 10,200 | 104 | | | | | 67,200 | 674 |
| Moonfish. | | | 100 | 3 | | | | | 1,675 | 57 |
| Mullet. | | | 527,400 | 8,785 | | | 200 | 18 | 1,272,751 | 46,531 |
| Parrotfish. | | | | | | | | | 3,500 | 70 |
| Permit. | | | 460 | 11 | 115 | 5 | 200 | 10 | 4,955 | 173 |
| Pigfish. | | | 5,400 | 162 | 150 | 6 | | | 9,350 | 282 |
| Pinfish or "sail-or's choice". | | | 349,610 | 10,095 | 50 | 23 | | | 381,709 | 11,087 |
| Pompano. | | | 37,435 | 8,615 | 625 | 94 | 4,000 | 400 | 163,757 | 15,755 |
| Porkfish. | | | | | | | | | 100 | 3 |
| Redfish or red drum. | | | 247,824 | 7,062 | 6,300 | 310 | 4,000 | 240 | 281,709 | 8,524 |
| Sea gar or needlefish. | | | | | | | | | 100 | 5 |
| Sergeantfish or snook. | | | 221,065 | 5,637 | | | | | 280,591 | 7,520 |
| Shad. | 102,161 | \$13,277 | | | | | 73,266 | 10,248 | 371,887 | 48,055 |
| Sharks. | | | 425 | 4 | | | | | 5,525 | 106 |
| Sheepshead. | | | 58,475 | 2,059 | 210 | 13 | 200 | 12 | 68,600 | 2,382 |
| Snapper: | | | | | | | | | | |
| Mangrove. | | | 825 | 26 | | | | | 3,045 | 115 |
| Mutton. | | | 137,293 | 3,953 | | | | | 185,573 | 5,443 |
| Spanish mackerel. | | | 6,473 | 627 | | | | | 173,095 | 11,310 |
| Spot. | | | 328,920 | 9,776 | 1,340 | 54 | 1,980 | 98 | 353,220 | 10,716 |
| Squeteague or "sea trout". | | | 314,105 | 27,363 | 8,342 | 695 | 12,000 | 1,200 | 372,208 | 32,758 |
| Yellowtail or "silver perch". | | | 23,290 | 654 | | | | | 42,310 | 1,225 |
| Sea crawfish or spiny lobster. | | | | | | | | | 652 | 33 |
| Turtles. | | | 600 | 30 | | | | | 850 | 42 |
| Total. | 102,161 | 13,277 | 3,258,190 | 125,785 | 27,902 | 1,560 | 485,875 | 22,324 | 5,949,060 | 262,135 |

¹ Includes 250,000 pounds of mullet, valued at \$7,560, caught with purse seines.

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.
BY GILL NETS.

| Species. | Brevard. | | Dade. | | Duval. | | Nassau. | | Palm Beach. | |
|--|-----------|---------|---------|--------|---------|---------|---------|----------|-------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Angelfish..... | | | | | | | | | 770 | \$25 |
| Barracuda..... | | | | | | | | | 2,235 | 67 |
| Black drum..... | 36,500 | \$1,095 | | | | | | | 2,450 | 73 |
| Bluefish..... | | | | | | | | | 249,202 | 24,838 |
| Blue runner or hardtail..... | | | 1,200 | \$36 | | | | | 22,175 | 665 |
| Bonito..... | | | | | | | | | 4,191 | 126 |
| Crevaille..... | 3,300 | 132 | 600 | 18 | | | | | 11,975 | 359 |
| Croaker..... | | | | | | | | | 12,538 | 376 |
| Flounders..... | 1,210 | 48 | | | | | | | 100 | 5 |
| Grunts..... | | | | | | | | | 5,230 | 159 |
| King whiting..... | 13,900 | 1,132 | | | | | | | 5,275 | 239 |
| Moonfish..... | | | 500 | 15 | | | | | 5,755 | 172 |
| Mullet..... | 1,292,600 | 171,704 | 408,600 | 16,314 | 50,000 | \$2,620 | | | 288,813 | 11,098 |
| Permit..... | | | | | | | | | 2,335 | 71 |
| Pigfish..... | 2,000 | 64 | | | | | | | 1,132 | 34 |
| Pinfish or sailor's choice..... | 43,150 | 1,386 | | | | | | | 2,825 | 85 |
| Pompano..... | 100 | 15 | | | | | | | 18,522 | 2,948 |
| Porgies..... | | | | | | | | | 100 | 3 |
| Porkfish..... | | | | | | | | | 1,260 | 37 |
| Red drum..... | 31,300 | 1,255 | | | | | | | 10,270 | 453 |
| Sea bass..... | | | | | | | | | 700 | 35 |
| Sergeantfish or snook..... | 400 | 15 | | | | | | | 7,341 | 221 |
| Shad..... | | | | | 265,608 | 36,825 | 61,250 | \$18,000 | 7,750 | 155 |
| Sharks..... | | | | | | | | | 3,890 | 162 |
| Sheepshead..... | 11,945 | 478 | | | | | | | | |
| Snapper: | | | | | | | | | | |
| Mangrove..... | 200 | 8 | | | | | | | 10,485 | 419 |
| Mutton..... | 1,400 | 54 | | | | | | | 33,420 | 1,027 |
| Spanish mackerel..... | | | 289,835 | 20,288 | | | | | 1,322,007 | 91,093 |
| Spot..... | 20,500 | 675 | | | | | | | 8,240 | 247 |
| Squeteague or "sea trout"..... | 518,400 | 42,252 | | | | | | | 67,198 | 6,149 |
| Yellowtail or "sil- ver perch"..... | | | | | | | | | 1,210 | 36 |
| Sea crawfish or spiny lobster..... | | | | | | | | | 1,443 | 71 |
| Total..... | 4,977,035 | 220,314 | 700,735 | 36,701 | 315,608 | 39,475 | 61,250 | 18,000 | 2,110,867 | 141,448 |

| Species. | Putnam. | | St. Lucie. | | St. John. | | Volusia. | | Total. | |
|--|---------|----------|------------|---------|-----------|--------|-----------|--------|------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Angelfish..... | | | 100 | \$3 | | | | | 1,870 | \$28 |
| Barracuda..... | | | | | | | | | 2,235 | 67 |
| Black drum..... | | | 900 | 20 | 8,000 | \$240 | 4,600 | \$138 | 52,450 | 1,566 |
| Bluefish..... | | | 125,038 | 11,306 | 100 | 12 | | | 374,340 | 36,156 |
| Blue runner or hardtail..... | | | | | | | | | 23,375 | 701 |
| Bonito..... | | | | | | | | | 4,191 | 126 |
| Crevaille..... | | | 3,920 | 117 | | | | | 19,795 | 626 |
| Croaker..... | | | | | 200 | 6 | | | 12,738 | 382 |
| Flounders..... | | | | | | | 800 | 32 | 2,110 | 85 |
| Grunts..... | | | 5,130 | 191 | | | | | 10,360 | 353 |
| King whiting..... | | | 4,137 | 375 | 1,300 | 65 | 650 | 51 | 25,562 | 1,865 |
| Moonfish..... | | | | | | | | | 6,255 | 187 |
| Mullet..... | | | 896,470 | 35,750 | 3,890 | 199 | 942,000 | 37,680 | 6,882,403 | 275,395 |
| Permit..... | | | | | | | | | 2,335 | 71 |
| Pigfish..... | | | 1,230 | 37 | 150 | 6 | 800 | 21 | 5,312 | 165 |
| Pinfish or sailor's choice..... | | | 9,660 | 309 | 210 | 8 | 4,400 | 132 | 60,245 | 1,920 |
| Pompano..... | | | 10,314 | 1,057 | 200 | 30 | | | 29,136 | 4,050 |
| Porgies..... | | | | | | | | | 100 | 3 |
| Porkfish..... | | | | | | | | | 1,260 | 37 |
| Red drum..... | | | 12,050 | 430 | 1,830 | 73 | 5,400 | 192 | 60,950 | 2,404 |
| Sea bass..... | | | | | | | | | 700 | 35 |
| Sergeantfish or snook..... | | | 11,855 | 345 | | | | | 19,626 | 581 |
| Shad..... | 264,861 | \$32,934 | | | | | | | 591,719 | 87,789 |
| Shark..... | | | | | | | | | 7,750 | 155 |
| Sheepshead..... | | | 2,082 | 66 | 175 | 11 | 300 | 12 | 18,292 | 729 |
| Snapper: | | | | | | | | | | |
| Mangrove..... | | | 2,666 | 80 | | | | | 13,351 | 507 |
| Mutton..... | | | 800 | 28 | | | | | 35,620 | 1,109 |
| Spanish mackerel..... | | | 689,748 | 55,211 | | | | | 2,301,590 | 166,592 |
| Spot..... | | | 5,220 | 162 | 1,690 | 61 | 3,600 | 108 | 39,160 | 1,256 |
| Squeteague or "sea trout"..... | | | | | | | | | | |
| Yellowtail or "sil- ver perch"..... | | | 353,429 | 30,183 | 7,320 | 505 | 84,000 | 7,460 | 1,030,347 | 86,549 |
| Sea crawfish or spiny lobster..... | | | | | | | | | 1,210 | 36 |
| Total..... | 264,861 | \$32,934 | 2,145,049 | 135,673 | 24,975 | 1,219 | 1,046,550 | 45,832 | 11,636,930 | 671,596 |

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY LINES.

| Species. | Brevard. | | Broward. | | Dade. | | Duval. | |
|-----------------------------------|----------|---------|----------|--------|-----------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Amberfish..... | | | 150 | \$12 | 200 | 88 | | |
| Angelfish..... | | | | | 175 | 7 | | |
| Barracuda..... | | | 150 | 12 | 200 | 8 | | |
| Black drum..... | | | | | | | 30,000 | \$900 |
| Bluefish..... | | | | | 300 | 30 | 1,500 | 150 |
| Blue runner or hardtail..... | | | | | 400 | 12 | | |
| Bonito..... | | | 100 | 10 | 50 | 3 | | |
| Cero or kingfish..... | | | 300 | 45 | 973,331 | 68,133 | | |
| Cowfish and "shellfish"..... | | | | | 50 | 2 | | |
| Crevalle..... | | | | | 200 | 8 | | |
| Grouper..... | | | 200 | 20 | 41,978 | 2,518 | | |
| Grunts..... | | | 200 | 20 | 10,650 | 426 | | |
| Hogfish..... | | | | | 150 | 6 | | |
| King whiting..... | | | | | | | 24,000 | 1,440 |
| Leather jacket or "turbot"..... | | | | | 200 | 8 | | |
| Moonfish..... | | | | | 40 | 1 | | |
| Pigfish..... | | | | | 100 | 4 | | |
| Pinfish or sailor's choice..... | | | | | 200 | 10 | | |
| Pompano..... | | | | | 360 | 54 | | |
| Porgies..... | | | | | 5,000 | 300 | | |
| Porkfish..... | | | | | 350 | 17 | | |
| Red drum..... | | | 100 | 12 | | | 24,000 | 1,440 |
| Sea bass..... | | | | | 100 | 8 | 20,000 | 1,600 |
| Sergeantfish or snook..... | | | 200 | 16 | | | | |
| Sheepshead..... | | | 50 | 5 | 100 | 6 | 14,000 | 840 |
| Snapper: | | | | | | | | |
| Mangrove..... | | | 300 | 30 | 2,700 | 135 | | |
| Mutton..... | | | 100 | 10 | 7,000 | 300 | | |
| Red..... | | | | | | | 19,200 | 1,920 |
| Spanish mackerel..... | | | | | 780 | 62 | | |
| Squeteague or "sea trout"..... | 73,082 | \$8,039 | | | 1,000 | 80 | 80,000 | 6,400 |
| Yellowtail or "silver perch"..... | | | | | 450 | 18 | | |
| Crabs, hard..... | | | | | | | 32,000 | 800 |
| Total..... | 73,082 | 8,039 | 1,850 | 192 | 1,046,564 | 72,164 | 244,700 | 15,490 |

| Species. | Palm Beach. | | St. John. | | Volusia. | | Total. | |
|-----------------------------------|-------------|--------|-----------|--------|----------|---------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Amberfish..... | 11,336 | \$370 | | | | | 11,686 | \$390 |
| Angelfish..... | | | | | | | 175 | 7 |
| Barracuda..... | 180 | 6 | | | | | 530 | 26 |
| Black drum..... | | | 1,300 | \$32 | | | 31,300 | 952 |
| Bluefish..... | 48,797 | 4,860 | 650 | 65 | | | 51,247 | 5,105 |
| Blue runner or hardtail..... | 250 | 7 | | | | | 650 | 19 |
| Bonito..... | 1,460 | 44 | 150 | 9 | | | 1,760 | 66 |
| Cero or kingfish..... | 1,280,161 | 78,350 | | | | | 2,233,792 | 146,528 |
| Cowfish and "shellfish"..... | | | | | | | 50 | 2 |
| Crevalle..... | 6,105 | 197 | | | | | 6,305 | 205 |
| Flounders..... | 100 | 5 | 170 | 10 | | | 270 | 15 |
| Grouper..... | 32,605 | 1,084 | | | | | 74,783 | 3,622 |
| Grunts..... | 5,840 | 175 | 150 | 9 | | | 16,840 | 630 |
| Hogfish..... | | | | | | | 150 | 6 |
| Jewfish..... | 5,667 | 179 | 220 | 9 | | | 5,887 | 188 |
| King whiting..... | | | | | | | 24,000 | 1,440 |
| Leather jacket or "turbot"..... | 170 | 5 | | | | | 370 | 13 |
| Moonfish..... | | | | | | | 40 | 1 |
| Pigfish..... | | | | | | | 100 | 4 |
| Pinfish or sailor's choice..... | | | | | | | 200 | 10 |
| Pompano..... | 80 | 16 | | | | | 440 | 70 |
| Porgies..... | 850 | 25 | | | | | 5,850 | 325 |
| Porkfish..... | | | | | | | 350 | 17 |
| Red drum..... | 800 | 32 | 1,200 | 48 | | | 26,100 | 1,532 |
| Sea bass..... | 19,121 | 986 | 1,410 | 70 | | | 40,631 | 2,664 |
| Sergeantfish or snook..... | 11,357 | 512 | | | | | 14,557 | 528 |
| Sharks..... | 500 | 15 | | | | | 500 | 15 |
| Sheepshead..... | 3,081 | 148 | | | | | 17,231 | 999 |
| Snapper: | | | | | | | | |
| Mangrove..... | 3,790 | 188 | | | | | 6,790 | 353 |
| Mutton..... | 12,285 | 537 | | | | | 19,885 | 847 |
| Red..... | 1,000 | 80 | | | | | 20,200 | 2,000 |
| Spanish mackerel..... | 5,190 | 514 | 1,510 | 151 | | | 7,480 | 727 |
| Squeteague or "sea trout"..... | 28,876 | 3,888 | 9,360 | 749 | 10,660 | \$3,660 | 242,318 | 22,756 |
| Yellowtail or "silver perch"..... | | | | | | | 450 | 18 |
| Crabs, hard..... | | | | | | | 32,000 | 800 |
| Total..... | 1,492,601 | 92,223 | 16,120 | 1,172 | 40,000 | 3,600 | 2,914,917 | 192,880 |

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY OTTER TRAWLS, CAST NETS, DIP NETS, TRAPS, AND SPEARS.

| Apparatus and species. | Dade. | | Duval. | | Nassau. | | St. John. | | Total. | |
|--|---------|---------|---------|--------|-----------|-----------|-----------|---------|-----------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Otter trawls: | | | | | | | | | | |
| Shrimp..... | | | | | 8,806,568 | \$264,197 | 61,350 | \$2,454 | 8,867,918 | \$266,651 |
| King whiting..... | | | | | 100,000 | 2,000 | | | 100,000 | 2,000 |
| Total..... | | | | | 8,906,568 | 266,197 | 61,350 | 2,454 | 8,967,918 | 268,651 |
| Cast nets: | | | | | | | | | | |
| Croaker..... | | | | | | | 700 | 28 | 700 | 28 |
| Black drum..... | | | | | | | 510 | 20 | 510 | 20 |
| Mullet..... | | | 12,000 | \$840 | | | 8,250 | 330 | 20,250 | 1,170 |
| Pinfish, or sailor's choice..... | | | | | | | 390 | 16 | 390 | 16 |
| Sheepshead..... | | | | | | | 80 | 5 | 80 | 5 |
| Spot..... | | | | | | | 650 | 26 | 650 | 26 |
| Squeteague or "sea trout"..... | | | | | | | 350 | 28 | 350 | 28 |
| Total..... | | | 12,000 | \$840 | | | 10,930 | 453 | 22,930 | 1,293 |
| Dip nets: Sea crawfish or spiny lobster..... | 21,408 | \$1,070 | | | | | | | 21,408 | 1,070 |
| Traps: Crabs, hard..... | | | 20,000 | 1,000 | | | | | 20,000 | 1,000 |
| Spears: Flounders..... | | | | | | | 7,500 | 450 | 7,500 | 450 |

BY RAKES, TONGS, AND HAND.

| Apparatus and species. | Dade. | | Duval. | | Nassau. | | Palm Beach. | |
|-------------------------------------|------------|--------|-----------|---------|----------|---------|-------------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Tongs: Oysters, market, public..... | | | 31,500 | \$1,800 | | | 2,100 | \$195 |
| By hand: | | | | | | | | |
| Oysters, market, public..... | | | | | 90,293 | \$3,315 | | |
| Oysters, market, private..... | | | | | 135,065 | 3,994 | 10,500 | 1,000 |
| Conch meat..... | | | | | | | 7,000 | 700 |
| Turtles ¹ | 6,000 | \$360 | | | | | | |
| Total..... | 6,000 | 360 | | | 225,358 | 7,309 | 17,500 | 1,700 |
| Apparatus and species. | St. Lucie. | | St. John. | | Volusia. | | Total. | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Rakes: Clams, hard..... | | | 2,400 | \$600 | | | 2,400 | \$600 |
| Tongs: Oysters, market, public..... | 4,900 | \$455 | 31,500 | 2,250 | 153,132 | \$7,119 | 223,132 | 11,819 |
| By hand: | | | | | | | | |
| Oysters, market, public..... | | | | | | | 90,293 | 3,315 |
| Oysters, market, private..... | | | | | | | 145,565 | 4,994 |
| Conch meat..... | | | | | | | 7,000 | 700 |
| Turtles ¹ | | | | | | | 6,000 | 360 |
| Total..... | | | | | | | 248,858 | 9,369 |

¹ Part of these were taken by gaffs.

INDUSTRIES.

Menhaden industry.—In 1918 there were 4 factories, valued at \$413,098, operated on the east coast of Florida, using \$40,000 in cash capital and employing 177 persons, to whom \$103,256 were paid in wages. The manufactured products, including the products of a factory in Georgia, follow: Oil, 125,478 gallons, valued at \$48,189; dried scrap, 444 tons, valued at \$37,296; acidulated scrap, 6,886

tons, valued at \$296,174; and crude or green scrap, 5,000 tons, valued at \$185,000.

Wholesale trade.—There were 50 firms engaged in the wholesale trade in fishery products, valued at \$534,644. These used \$101,600 in cash capital and gave employment to 416 persons, to whom \$189,421 were paid in wages.

Canning industry.—In 1918 there were 3 canneries, valued at \$92,023, using cash capital to the amount of \$15,000 and employing 275 persons, to whom \$34,306 were paid in wages. The products prepared consisted of canned oysters to the value of \$17,210, and canned shrimp to the value of \$118,660.

The following tables contain detailed statistics of these industries in 1918:

INDUSTRIES ON THE EAST COAST OF FLORIDA, 1918.

MENHADEN INDUSTRY.

| Item. | Number. | Value. | Item. | Number. | Value. |
|----------------------|---------|-----------|---------------------------------|----------------------|----------|
| Establishments..... | 4 | \$413,098 | PRODUCTS. | | |
| Cash capital..... | | 40,000 | | | |
| Persons engaged..... | 177 | | | | |
| Wages paid..... | | 103,256 | | | |
| | | | | | |
| | | | Oil.....gallons.. | ¹ 125,478 | \$48,189 |
| | | | Dry scrap.....tons.. | 444 | 37,296 |
| | | | Acidulated scrap.....do.... | 6,886 | 296,174 |
| | | | Crude or green scrap.....do.... | ¹ 5,000 | 185,000 |

OYSTER AND SHRIMP CANNING INDUSTRY.

| | | | | | |
|--------------------------|--------------------|----------|------------------------|---------------------|----------|
| Establishments..... | 3 | \$92,023 | PRODUCTS—continued. | | |
| Cash capital..... | | 15,000 | | | |
| Persons engaged..... | 275 | | | | |
| Wages paid..... | | 34,306 | | | |
| | | | | | |
| PRODUCTS. | | | Shrimp, canned: | | |
| Oysters, canned: | | | No. 1 cans.....cases.. | ² 15,317 | \$75,920 |
| 4-ounce cans.....cases.. | ² 500 | 2,700 | No. 1½ cans.....do.... | ³ 8,503 | 42,740 |
| 5-ounce cans.....do.... | ² 1,434 | 8,030 | Total..... | | 118,660 |
| 8-ounce cans.....do.... | ² 1,200 | 6,480 | | | |
| Total..... | | 17,210 | | | |

¹ Includes one factory in Georgia.² Four dozen cans per case.³ Two dozen cans per case.

SUMMARY OF THE FISHERIES OF FLORIDA IN 1918.

In the following table the fisheries of both coasts of Florida are combined for purposes of comparison and study of the State as a whole with other States of the region. In 1918 the fisheries of the State gave employment to 8,491 persons, the total investment amounted to \$1,614,924, and the products amounted to 135,965,127 pounds, valued at \$5,166,538. Of the South Atlantic and Gulf States, Florida ranks first in the number of persons engaged, investment, and quantity and value of products, and North Carolina second. Louisiana ranks third, excepting in quantity of products, Georgia and Texas having larger quantities accredited to them.

FISHERIES OF FLORIDA IN 1918.

| Item. | East coast. | | West coast. | | Total. | |
|-----------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| PERSONS ENGAGED. | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> |
| On vessels fishing..... | 380 | | 623 | | 1,003 | |
| On vessels transporting..... | 15 | | 70 | | 85 | |
| In shore fisheries..... | 2,104 | | 3,600 | | 5,704 | |
| Shoremen..... | 841 | | 888 | | 1,699 | |
| Total..... | 3,330 | | 5,161 | | 8,491 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Gasoline..... | 23 | \$377,600 | 33 | \$92,630 | 56 | \$470,230 |
| Tonnage..... | 725 | | 360 | | 1,085 | |
| Outfit..... | | 71,287 | | 27,043 | | 98,330 |
| Sail..... | | | 62 | 309,800 | 62 | 309,800 |
| Tonnage..... | | | 2,069 | | 2,069 | |
| Outfit..... | | | | 71,520 | | 71,520 |
| Vessels transporting: | | | | | | |
| Gasoline..... | 7 | 32,300 | 34 | 105,800 | 41 | 138,100 |
| Tonnage..... | 80 | | 455 | | 544 | |
| Outfit..... | | 3,850 | | 22,444 | | 26,294 |
| Sail..... | | | 50 | 80,650 | 50 | 80,650 |
| Tonnage..... | | | 1,025 | | 1,025 | |
| Boats: | | | | | | |
| Sail, row, etc..... | 607 | 20,180 | 2,019 | 123,900 | 2,626 | 140,080 |
| Power..... | 839 | 459,650 | 1,018 | 438,962 | 1,857 | 898,612 |
| Apparatus, vessel fisheries: | | | | | | |
| Seines..... | 25 | 52,900 | 1 | 1,690 | 26 | 54,500 |
| Gill nets..... | | | 6 | 120 | 6 | 120 |
| Lines..... | | | | 5,379 | | 5,379 |
| Otter trawls..... | | | 16 | 720 | 16 | 720 |
| Tongs..... | | | 12 | 120 | 12 | 120 |
| Sponge apparatus..... | | | | 210 | | 210 |
| Other apparatus..... | | | | 2 | | 2 |
| Apparatus, shore fisheries: | | | | | | |
| Seines..... | 117 | 61,030 | 163 | 61,175 | 280 | 122,205 |
| Trammel nets..... | | | 146 | 11,990 | 146 | 11,990 |
| Gill nets..... | 715 | 101,725 | 1,795 | 106,070 | 2,510 | 207,795 |
| Stop nets..... | | | 136 | 6,810 | 136 | 6,810 |
| Cast nets..... | 16 | 80 | | | 16 | 80 |
| Lines..... | | 2,965 | | 2,046 | | 5,011 |
| Otter trawls..... | 255 | 16,500 | 107 | 4,770 | 362 | 21,270 |
| Tongs, grabs, and rakes..... | 37 | 224 | 284 | 2,616 | 321 | 2,840 |
| Spears or gigs..... | 12 | 12 | | | 12 | 12 |
| Crab traps and drags..... | 20 | 50 | | | 20 | 50 |
| Sponge apparatus..... | | | | 70,935 | | 70,935 |
| Other apparatus..... | | 6 | | 12,696 | | 12,696 |
| Shore and accessory property..... | | 858,720 | | 619,987 | | 1,478,707 |
| Cash capital..... | | 151,600 | | 219,350 | | 370,950 |
| Total..... | | 2,210,679 | | 2,404,245 | | 4,614,924 |
| PRODUCTS. | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Alewives..... | 692,265 | \$10,373 | | | 692,265 | \$10,373 |
| Amberfish..... | 11,686 | 390 | 11,100 | \$413 | 22,786 | 803 |
| Angelfish..... | 2,915 | 91 | 20,825 | 798 | 23,740 | 889 |
| Barrauda..... | 2,915 | 97 | 4,860 | 232 | 7,775 | 329 |
| Bluefish: | | | | | | |
| Fresh..... | 561,301 | 54,715 | 246,168 | 17,411 | 807,469 | 72,126 |
| Salted..... | | | 12,240 | 915 | 12,240 | 915 |
| Blue runner or hardtail: | | | | | | |
| Fresh..... | 50,750 | 1,542 | 324,648 | 6,935 | 375,398 | 8,477 |
| Salted..... | | | 65,430 | 2,734 | 65,430 | 2,734 |
| Bonito..... | 8,141 | 258 | 50,955 | 2,045 | 59,096 | 2,303 |
| Butterfish..... | 4,200 | 170 | | | 4,200 | 170 |
| Catfish..... | 13,900 | 278 | 51,427 | 3,126 | 65,327 | 3,404 |
| Cero and king fish..... | 2,271,792 | 147,608 | 465,860 | 31,903 | 2,737,652 | 179,511 |
| Cowfish and "shellfish"..... | 50 | 2 | 300 | 12 | 350 | 14 |
| Crevaille..... | 321,030 | 9,833 | 105,927 | 3,800 | 426,957 | 13,633 |
| Croaker..... | 124,278 | 3,447 | | | 124,278 | 3,447 |
| Drum, red and black..... | 900,091 | 24,638 | 994,910 | 39,803 | 1,895,001 | 64,441 |
| Elops or ten-pounder: | | | | | | |
| Fresh..... | | | 267,940 | 5,402 | 267,940 | 5,402 |
| Salted..... | | | 9,883 | 334 | 9,883 | 334 |
| Flounders..... | 13,490 | 737 | 37,381 | 2,089 | 50,871 | 2,826 |
| Groupers..... | 74,783 | 3,622 | 5,626,329 | 222,215 | 5,701,112 | 225,837 |
| Grunts..... | 113,679 | 3,629 | 87,349 | 3,618 | 201,028 | 7,247 |
| Hogfish..... | 250 | 11 | 7,344 | 336 | 7,594 | 347 |
| Jewfish..... | 12,487 | 365 | 69,844 | 2,704 | 82,331 | 3,069 |
| King whiting..... | 297,008 | 15,604 | 35,188 | 2,126 | 332,196 | 17,730 |

FISHERIES OF FLORIDA IN 1913—Continued.

| Item. | East coast. | | West coast. | | Total. | |
|-----------------------------------|-------------|-----------|-------------|-----------|-------------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| PRODUCTS—continued. | | | | | | |
| Ladyfish..... | 1,280 | \$13 | | | 1,280 | 13 |
| Leather jacket or "turbot"..... | 370 | 13 | 7,136 | 837 | 8,506 | 850 |
| Menhaden: | | | | | | |
| Fresh..... | 48,262,660 | 210,175 | 263,530 | 6,779 | 48,526,190 | 216,954 |
| Salted..... | | | 21,022 | 669 | 21,022 | 669 |
| Moonfish..... | 7,970 | 245 | 650 | 23 | 8,620 | 268 |
| Mullet: | | | | | | |
| Fresh..... | 10,417,889 | 397,147 | 23,569,736 | 973,129 | 33,987,625 | 1,370,276 |
| Salted..... | | | 2,453,930 | 177,974 | 2,453,930 | 177,974 |
| Mullet roe, salted..... | | | 86,285 | 17,593 | 86,285 | 17,593 |
| Parrotfish..... | 3,500 | 79 | | | 3,500 | 79 |
| Permit..... | 7,290 | 244 | 7,865 | 294 | 15,155 | 538 |
| Pigfish..... | 14,762 | 151 | 6,596 | 230 | 21,358 | 701 |
| Pinfish or sailor's choice..... | 412,535 | 13,683 | 21,132 | 809 | 433,667 | 14,492 |
| Pompano: | | | | | | |
| Fresh..... | 133,419 | 19,889 | 235,992 | 27,262 | 369,411 | 47,151 |
| Salted..... | | | 3,075 | 590 | 3,075 | 590 |
| Porgies..... | 5,950 | 248 | 56,742 | 2,442 | 62,692 | 2,790 |
| Porkfish..... | 1,710 | 57 | 2,409 | 144 | 4,119 | 201 |
| Redfish or red drum, salted..... | | | 7,321 | 366 | 7,321 | 366 |
| Sea bass..... | | | 300 | 10 | 300 | 10 |
| Sea gar or needlefish..... | 41,331 | 2,099 | 31,644 | 2,180 | 72,975 | 4,279 |
| Sergeantfish or snook..... | 100 | 5 | | | 100 | 5 |
| Shad..... | 314,774 | 3,629 | 73,745 | 2,368 | 388,519 | 11,107 |
| Sharks..... | 963,606 | 135,844 | | | 963,606 | 135,844 |
| Sheepshead..... | 63,775 | 126 | | | 63,775 | 126 |
| Snappers: | | | | | | |
| Mangrove..... | 104,303 | 4,115 | 988,662 | 32,627 | 1,092,965 | 36,742 |
| Mutton..... | 23,186 | 955 | 103,999 | 4,359 | 127,185 | 5,354 |
| Red..... | 241,078 | 7,399 | 14,100 | 534 | 255,178 | 7,933 |
| Spanish mackerel: | | | | | | |
| Fresh..... | 20,200 | 2,000 | 7,230,168 | 455,640 | 7,250,368 | 457,640 |
| Salted..... | 3,061,965 | 218,085 | 3,408,701 | 244,026 | 6,470,666 | 462,111 |
| Spot..... | | | 27,200 | 1,565 | 27,200 | 1,565 |
| Squeteague or "sea trout": | | | 37,977 | 1,519 | 37,977 | 1,519 |
| Fresh..... | 393,030 | 11,998 | | | 393,030 | 11,998 |
| Salted..... | 1,645,223 | 142,301 | 1,630,686 | 145,534 | 3,275,909 | 287,835 |
| Sturgeon..... | | | 31,625 | 3,772 | 31,625 | 3,772 |
| Sturgeon caviar and roe..... | | | 4,915 | 620 | 4,915 | 620 |
| Tang..... | | | 12 | 12 | 12 | 12 |
| Tarpon..... | | | 600 | 30 | 600 | 30 |
| Yellowtail..... | | | 1,800 | 180 | 1,800 | 180 |
| Yellowtail or "silver perch"..... | | | 31,735 | 1,537 | 31,735 | 1,537 |
| Shrimp..... | 43,970 | 6,290 | | | 43,970 | 6,290 |
| Sea crawfish..... | 8,867,918 | 208,651 | 3,250,468 | 81,408 | 12,118,386 | 348,059 |
| Crabs: | | | | | | |
| Hard..... | 23,503 | 1,174 | 322,015 | 16,064 | 345,518 | 17,238 |
| Soft..... | 52,000 | 1,800 | | | 52,000 | 1,800 |
| Terrapin..... | | | 21,500 | 2,600 | 21,500 | 2,600 |
| Turtles..... | | | 2,475 | 206 | 2,475 | 206 |
| Clams, hard..... | 6,850 | 902 | 65,370 | 4,429 | 72,220 | 5,331 |
| Conch meat..... | 2,400 | 600 | 160,872 | 11,336 | 163,272 | 11,936 |
| Oysters, market: | | | | | | |
| Public..... | 7,000 | 700 | 2,060 | 100 | 9,060 | 800 |
| Private..... | 313,425 | 15,104 | 2,602,416 | 121,019 | 2,915,841 | 136,183 |
| Sponges: | | | | | | |
| Blue..... | 145,365 | 4,994 | 13,496 | 771 | 158,861 | 5,765 |
| Green..... | | | 2,022 | 215 | 2,022 | 215 |
| Orange..... | | | 73,033 | 12,125 | 73,033 | 12,125 |
| Purple..... | | | 276,168 | 675,781 | 276,168 | 675,781 |
| Wire..... | | | 9,324 | 2,817 | 9,324 | 2,817 |
| Yellow..... | | | 91,611 | 34,187 | 91,611 | 34,187 |
| Total..... | 81,211,488 | 1,746,175 | 54,753,639 | 3,420,363 | 135,965,127 | 5,166,538 |

1 150,000 in number.

2 20,400 bushels.

3 416,553 bushels.

4 22,723 bushels.

SPONGE FISHERY OF FLORIDA.

The sponge fishery of Florida is prosecuted on the west coast of the State, and the catch is sold by bunches chiefly through the sponge exchange at Tarpon Springs. The large wool and grass sponges are estimated at 21 pounds per bunch, small wool sponges at 1 pound, and yellow and wire sponges at 1½ pounds. In 1919 the quantity sold at the exchange amounted to 424,075 pounds, valued at \$707,964,

and in 1920 to 400,746 pounds, valued at \$678,209. A considerable quantity is also sold at Key West.

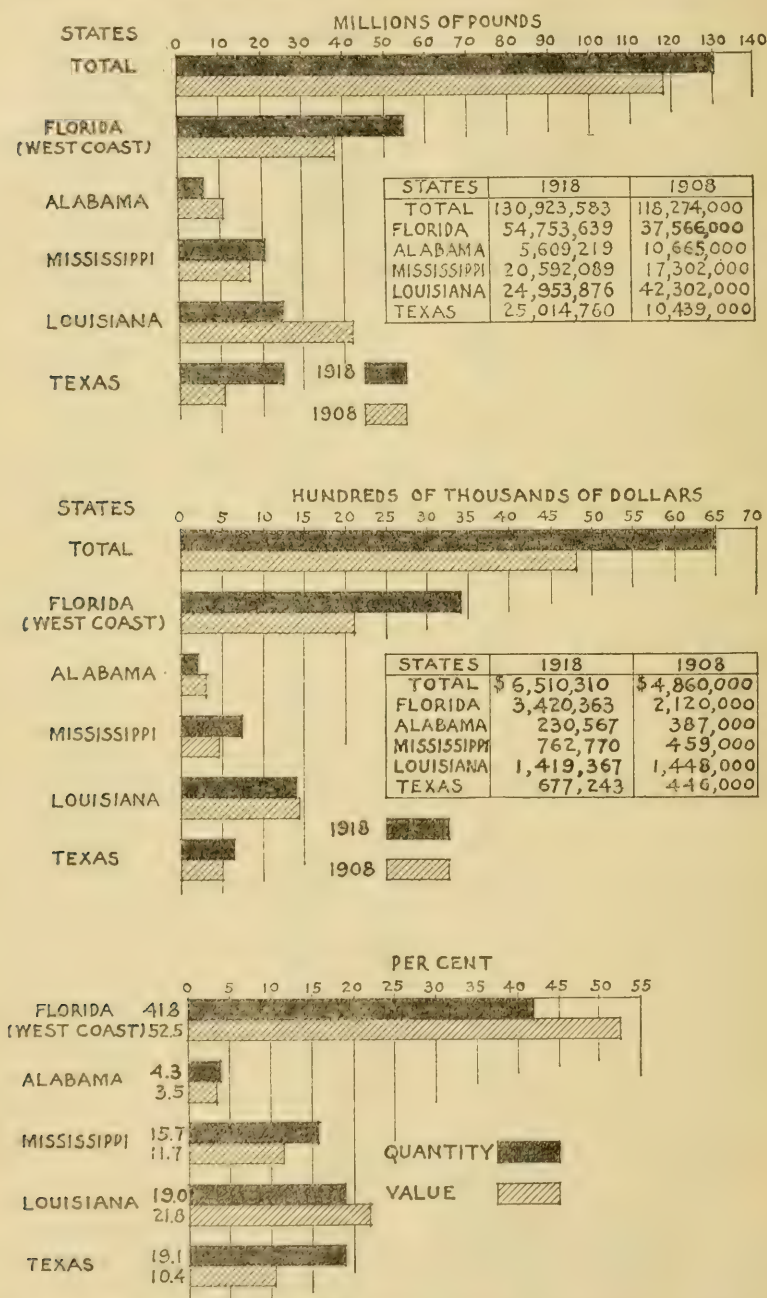


FIG. 8. — Top: Quantity of fish taken in the commercial fisheries of the Gulf States in 1918 compared with 1908. Center: Values of fish taken in the commercial fisheries of the Gulf States in 1918 compared with 1908. Bottom: Percentages of total quantity and value of fishery products for each of the Gulf States in 1918.

Following are statistics of the quantity in pounds based on the above conversion figures of the different kinds of sponges sold at the exchange at Tarpon Springs in 1919 and 1920:

SPONGES SOLD AT THE EXCHANGE, TARPON SPRINGS, FLA., 1919 AND 1920.

| Kind. | 1919 | | 1920 | |
|-----------------|---------|-----------|---------|-----------|
| | Pounds. | Value. | Pounds. | Value. |
| Large wool..... | 205,462 | \$544,222 | 176,722 | \$522,399 |
| Small wool..... | 76,309 | 95,386 | 60,902 | 79,172 |
| Yellow..... | 73,051 | 39,161 | 72,648 | 33,499 |
| Grass..... | 62,547 | 25,171 | 92,880 | 29,722 |
| Wire..... | 6,706 | 4,024 | 6,594 | 3,417 |
| Total..... | 424,075 | 707,964 | 409,746 | 678,209 |

SUMMARIES OF THE FISHERIES OF THE GULF STATES FOR VARIOUS YEARS.

In the appended table are given comparative statistics showing the number of persons engaged, investment, and quantities and values of the products of the fisheries of the Gulf States for various years from 1880 to 1918. A similar summary of the fisheries of the South Atlantic States for the same years appears on page 65 of this report. In view of the increasing attention which the fisheries of these regions are receiving, these will serve to indicate the relative rate of growth and development of these fisheries.

EXTENT OF FISHERIES OF THE GULF STATES, VARIOUS YEARS, 1880 TO 1918.¹

| Item. | 1880 | 1887 | 1888 | 1889 |
|---------------------------|------------|------------------|------------------|-------------|
| PERSONS ENGAGED. | | | | |
| Florida (west coast)..... | 2,112 | (²) | 3,066 | 3,739 |
| Alabama..... | 635 | (²) | 318 | 594 |
| Mississippi..... | 186 | 1,153 | 1,380 | 1,809 |
| Louisiana..... | 1,597 | 3,607 | 3,758 | 3,966 |
| Texas..... | 601 | 1,027 | 1,021 | 1,211 |
| Total..... | 5,131 | (²) | 9,543 | 11,319 |
| INVESTMENT. | | | | |
| Florida (west coast)..... | \$362,563 | (²) | \$613,736 | \$1,281,150 |
| Alabama..... | 38,200 | (²) | 61,904 | 126,925 |
| Mississippi..... | 8,800 | \$284,760 | 329,632 | 455,300 |
| Louisiana..... | 93,621 | 633,607 | 664,927 | 706,557 |
| Texas..... | 42,400 | 206,591 | 214,511 | 256,431 |
| Total..... | 545,584 | (²) | 1,884,710 | 2,826,403 |
| PRODUCTS. ³ | | | | |
| Pounds: | | | | |
| Florida (west coast)..... | 8,376,335 | (²) | (²) | 23,597,240 |
| Alabama..... | 3,541,500 | (²) | 1,633,589 | 4,560,269 |
| Mississippi..... | 788,500 | 6,548,175 | 7,833,010 | 8,933,339 |
| Louisiana..... | 6,996,000 | 18,455,489 | 19,121,056 | 20,947,239 |
| Texas..... | 3,858,875 | 6,282,489 | 6,609,161 | 7,357,800 |
| Total..... | 23,561,210 | (²) | (²) | 65,395,887 |
| Value: | | | | |
| Florida (west coast)..... | \$564,819 | (²) | \$628,396 | \$948,845 |
| Alabama..... | 119,273 | (²) | 75,990 | 149,841 |
| Mississippi..... | 22,540 | \$189,716 | 231,712 | 250,884 |
| Louisiana..... | 392,610 | 579,504 | 612,820 | 621,048 |
| Texas..... | 128,300 | 256,250 | 271,257 | 297,258 |
| Total..... | 1,227,544 | (²) | 1,819,745 | 2,264,876 |

¹ Statistics for 1908 are from data published by the Bureau of the Census.

² Statistics not available.

³ The quantity and value of products given for Florida for 1888 in the report of the Division of Statistics and Methods of the Fisheries for 1919, page 157, include both coasts of the State, and those for Alabama for 1908 include the Tennessee River district.

EXTENT OF FISHERIES OF THE GULF STATES, VARIOUS YEARS, 1880 TO 1918—Contd.

| Item. | 1890 | 1897 | 1902 | 1908 | 1918 |
|---------------------------|-------------|-------------|-------------|-------------|-------------|
| PERSONS ENGAGED. | | | | | |
| Florida (west coast)..... | 4,068 | 5,011 | 6,416 | 6,016 | 5,161 |
| Alabama..... | 618 | 789 | 1,098 | 895 | 783 |
| Mississippi..... | 1,721 | 2,565 | 4,344 | 1,561 | 2,867 |
| Louisiana..... | 4,068 | 4,403 | 5,027 | 5,152 | 4,191 |
| Texas..... | 1,277 | 1,199 | 1,144 | 1,780 | 1,886 |
| Total..... | 11,752 | 13,967 | 18,029 | 15,404 | 14,888 |
| INVESTMENT. | | | | | |
| Florida (west coast)..... | \$1,369,294 | \$1,149,262 | \$1,945,320 | \$1,884,000 | \$2,404,245 |
| Alabama..... | 135,290 | 165,189 | 328,285 | 262,000 | 334,741 |
| Mississippi..... | 434,710 | 518,301 | 1,270,408 | 461,000 | 1,433,585 |
| Louisiana..... | 719,876 | 513,813 | 789,723 | 841,000 | 1,475,188 |
| Texas..... | 319,122 | 237,496 | 373,724 | 454,000 | 890,100 |
| Total..... | 2,978,292 | 2,584,061 | 4,707,460 | 3,902,000 | 6,537,859 |
| PRODUCTS. ² | | | | | |
| Pounds: | | | | | |
| Florida (west coast)..... | 27,418,562 | 28,255,219 | 48,120,019 | 37,566,000 | 54,753,639 |
| Alabama..... | 4,776,968 | 4,699,381 | 9,351,447 | 9,918,450 | 5,609,219 |
| Mississippi..... | 8,131,401 | 7,829,085 | 23,426,965 | 17,302,000 | 20,592,089 |
| Louisiana..... | 20,789,203 | 17,401,788 | 24,754,135 | 42,302,000 | 24,953,876 |
| Texas..... | 7,959,400 | 7,174,550 | 8,044,404 | 10,439,000 | 25,014,700 |
| Total..... | 69,075,534 | 65,360,623 | 113,696,970 | 117,527,450 | 130,923,583 |
| Value: | | | | | |
| Florida (west coast)..... | \$1,064,139 | \$944,703 | \$1,462,166 | \$2,120,000 | \$3,420,363 |
| Alabama..... | 154,871 | 134,438 | 266,682 | 358,000 | 230,567 |
| Mississippi..... | 245,699 | 192,298 | 553,220 | 459,000 | 762,770 |
| Louisiana..... | 660,134 | 713,587 | 838,314 | 1,448,000 | 1,410,367 |
| Texas..... | 313,832 | 286,610 | 353,814 | 446,000 | 677,243 |
| Total..... | 2,438,675 | 2,271,726 | 3,494,196 | 4,831,009 | 6,510,310 |

¹ Exclusive of persons and investment in canneries, packing houses, and other establishments.

² The quantity and value of products given for Florida for 1888 in the report of the Division of Statistics and Methods of the Fisheries for 1919, page 137, include both coasts of the State, and those for Alabama for 1908 include the Tennessee River district.

FISHERIES OF THE NEW ENGLAND STATES IN 1919.

The statistics of the coast fisheries of the New England States presented in this report are for the calendar year 1919 and have been published in summarized form in Statistical Bulletin No. 497.¹¹

Included in this report are statistics of the sardine industry of Maine for 1919 and 1920 and the salmon fishery of the Penobscot River and Bay for 1918, 1919, and 1920.

EARLIER PUBLICATIONS.

Some of the previous publications containing statistical information on the fisheries of the New England States and published in Washington, D. C., follow:

1873. Report on the Conditions of the Sea Fisheries of the South Coast of New England in 1871 and 1872. By Spencer F. Baird. Report, U. S. Commission of Fish and Fisheries, 1871 and 1872 (1873), p. i-xli.
1887. The Coast of Maine and Its Fisheries. By R. Edward Earll. In *The Fisheries and Fishery Industries of the United States*, by G. Brown Goode et al., Sec. II, Pt. I, p. 5-102.
- The Fisheries of New Hampshire. By W. A. Wilcox. *Ibid.*, Sec. II, Pt. II, p. 103-112.

¹¹ The statistical data were collected by Winthrop A. Roberts, Rob Leon Greer, Andrew J. Messner, Walter H. Rich, Lawrence T. Hopkinson, and Fred F. Johnson, statistical agents of the Bureau.

1887. The Fisheries of Massachusetts. By A. Howard Clark. Ibid., Sec. II, Pt. III, p. 113-280.
The Fisheries of Rhode Island. By A. Howard Clark. Ibid., Sec. II, Pt. IV, p. 281-310.
The Coast of Connecticut and Its Fisheries. By A. Howard Clark. Ibid., Sec. V, p. 311-340.
History and Methods of the Fisheries. Ibid., Sec. V, Vol. I (xi+808 p.), Vol. II (xx+881 p.), and atlas of 275 pls.
1889. The Sea Fisheries of Eastern North America. By Spencer F. Baird. Appendix A, Report, U. S. Commission of Fish and Fisheries, 1886 (1889), 224 p.
1891. Notes on the Oyster Fishery of Connecticut. By J. W. Collins. Bulletin, U. S. Fish Commission, Vol. IX, 1889 (1891), p. 461-497, Pl. CLIX-CLXVI.
1892. III. Fisheries of the New England States [1887 and 1888]. In Statistical Review of the Coast Fisheries of the United States, prepared under the direction of J. W. Collins. Report, U. S. Commission of Fish and Fisheries, 1888 (1892), p. 286-322.
Report on the Fisheries of the New England States. By J. W. Collins and Hugh M. Smith. Bulletin, U. S. Fish Commission, Vol. X, 1890 (1892), p. 73-176.
1898. The Herring Industry of the Passamaquoddy Region, Maine. By Ansley Hall. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), p. 443-487.
1899. The Shad Fisheries of the Atlantic Coast of the United States. By Charles H. Stevenson. Report, U. S. Commission of Fish and Fisheries, 1898 (1899), p. 101-269.
1901. The Lobster Fishery of Maine. By John N. Cobb. Bulletin, U. S. Fish Commission, Vol. XIX, 1899 (1901), p. 241-265, illus., pl. 23-32.
Statistics of the Fisheries of the New England States. Report, U. S. Commission of Fish and Fisheries, 1900 (1901), p. 311-386.
1905. Statistics of the Fisheries of the New England States, 1902. Report, U. S. Bureau of Fisheries, 1904 (1905), p. 245-325.
1908. Statistics of the Fisheries of the New England States for 1905. Report and Special Papers, U. S. Bureau of Fisheries, 1906 (1908), 93 p.
1911. Fisheries of the United States, 1908. Special Reports, Bureau of the Census, 1911.

COMMON AND SCIENTIFIC NAMES OF FISHES.

Following is a list of the common and scientific names of the fishes of New England States to which reference is made in the present report. If the trade will adopt the common names employed herein, it is believed that much of the confusion now encountered will be avoided and that in this way the consumer may be educated to the relative merits of individual species.

| | |
|-------------------|-------------------------------------|
| Alewives..... | { <i>Pomolobus astivalis</i> . |
| Bluefish..... | { <i>Pomolobus pseudoharengus</i> . |
| Bonito..... | <i>Pomatomus saltatrix</i> . |
| Bullhead..... | <i>Sarda sarda</i> . |
| Butterfish..... | <i>Ameiurus nebulosus</i> . |
| Carp..... | <i>Poronotus triacanthus</i> . |
| Cod..... | <i>Cyprinus carpio</i> . |
| Cunner..... | <i>Gadus callarias</i> . |
| Cusk..... | <i>Tautoglabrus adspersus</i> . |
| Eels..... | <i>Brosmus brosme</i> . |
| Flounders..... | { <i>Anguilla rostrata</i> . |
| Grayfish..... | { <i>Leptocephalus conger</i> . |
| Halibut..... | <i>Neuronectidae</i> (species). |
| Haddock..... | <i>Squalus acanthias</i> . |
| Hake..... | { <i>Merluccius merluccius</i> . |
| Halibut..... | { <i>Urophycis tenuis</i> . |
| Herring..... | { <i>Urophycis chus</i> . |
| Hickory shad..... | <i>Hippoglossus hippoglossus</i> . |
| ..... | <i>Clupea harengus</i> . |
| ..... | <i>Pomolobus mediocris</i> . |
| ..... | <i>Merluccius setulatus</i> . |

| | |
|-----------------------|--|
| Launce..... | <i>Ammodytes americanus.</i> |
| Mackerel..... | <i>Scomber scombrus.</i> |
| Menhaden..... | <i>Brevoortia tyrannus.</i> |
| Moikfish..... | <i>Lophius piscatorius.</i> |
| Minnows..... | Various species small fishes. |
| Perch, white..... | <i>Morone americana.</i> |
| Perch, yellow..... | <i>Perca flavescens.</i> |
| Pickarel..... | <i>Esox reticulatus.</i> |
| Pollock..... | <i>Pollachius virens.</i> |
| Pompano..... | <i>Trachinotus (species).</i> |
| Rosefish..... | <i>Sebastes marinus.</i> |
| Round herring..... | <i>Etruncus teres.</i> |
| Salmon, Atlantic..... | <i>Salmo salar.</i> |
| Salmon, humpback..... | <i>Oncorhynchus gorbuscha.</i> |
| Sculpins..... | <i>Cottidae (species).</i> |
| Scup..... | <i>Stenotomus chrysops.</i> |
| Sea bass..... | <i>Centropristes striatus.</i> |
| Sea robin..... | <i>Prionotus carolinus.</i> |
| Shad..... | <i>Prionotus strigatus.</i> |
| Sharks..... | <i>Alosa sapidissima.</i> |
| Skates and rays..... | All <i>Selachii</i> except <i>Batoidei</i> . |
| Smelt..... | <i>Batoidei (species).</i> |
| Squeteague..... | <i>Osmerus mordax.</i> |
| Striped bass..... | <i>Cynoscion regalis.</i> |
| Sturgeon..... | <i>Roccus lineatus.</i> |
| Suckers..... | <i>Acipenser sturio.</i> |
| Sunfish..... | <i>Catostomidae (species).</i> |
| Swordfish..... | <i>Centrarchidae (species).</i> |
| Tautog..... | <i>Xiphias gladius.</i> |
| Tilefish..... | <i>Tautoga onitis.</i> |
| Tomcod..... | <i>Lopholatilus chamaeleonticeps.</i> |
| Tuna..... | <i>Microgadus tomcod.</i> |
| Whiting..... | <i>Thunnus thynnus.</i> |
| Wolffish..... | <i>Merluccius bilinearis.</i> |
| | <i>Anarhichas lupus.</i> |

GENERAL STATISTICS.

The fisheries of the New England States in 1919 gave employment to 30,767 persons, of whom 6,346 were on vessels fishing, 533 on vessels transporting fishery products, 10,968 in the shore or boat fisheries, and 12,920 shoresmen in the wholesale fishery trade, canneries, smokehouses, oysterhouses, and other shore industries connected with the fisheries. The number of persons engaged in the fisheries of the different States follows: Maine, 14,386; Massachusetts, 12,346; Connecticut, 2,289; Rhode Island, 1,646; and New Hampshire, 100. Compared with the returns for 1905, the year for which the last canvass was made by the Bureau, there has been a decrease in the number of persons employed in all of the States of 6,572 persons, or 17.60 per cent. The decrease by States follows: Massachusetts, 3,318 persons, or 21.33 per cent; Maine, 1,495 persons, or 9.41 per cent; Connecticut, 1,118 persons, or 32.81 per cent; Rhode Island, 566 persons, or 25.59 per cent; and New Hampshire, 45 persons, or 31.03 per cent.

The total amount of capital invested in the fisheries and fishery industries of these States in 1919 was \$40,597,097. There has been an increase of \$18,066,377, or 80.18 per cent, in money invested in the fisheries and fishery industries of the region since 1905. In Maine the investment amounted to \$17,544,969, an increase of \$8,572,920, or 95.55 per cent, as compared with 1905. In Massachusetts the investment was \$19,111,269, an increase of \$8,300,827,

or 76.79 per cent, compared with 1905. In Rhode Island the investment amounted to \$2,249,536, an increase of \$1,184,110, or 111.14 per cent. In Connecticut the investment was \$1,645,793, an increase of \$10,040, or 0.61 per cent, as compared with 1905; and in New Hampshire the investment in 1919 was \$45,530, a decrease of \$1,520, or 3.23 per cent, as compared with 1905. The investment included 757 fishing vessels, valued at \$8,501,081, having a net tonnage of 24,099 tons and outfits valued at \$2,400,500; 221 transporting vessels, valued at \$741,005, having a net tonnage of 3,214 tons and outfits valued at \$185,425; 10,364 boats, valued at \$2,280,713; fishing apparatus used by vessels and boats, valued at \$2,888,332; shore and accessory property to the value of \$20,354,089; and cash or working capital to the amount of \$3,245,952. The principal forms of fishing apparatus arranged in order of value are pound nets, trap nets, and weirs, 1,119 in number, valued at \$1,087,997; lobster pots, 239,558, valued at \$612,207; seines, 441, valued at \$415,507; gill nets, 14,616, valued at \$324,246; and lines valued at \$287,579.

The use of the otter trawl introduced in the vessel and shore fisheries for the capture of ground fish probably represents the most important change in apparatus since 1905. In 1905 none were reported in operation, while in 1919 there were 492, valued at \$37,987.

The combined catch of all the New England States amounted to 467,339,870 pounds, valued at \$19,838,657. Of this amount the largest quantity, amounting to 246,951,241 pounds, valued at \$10,859,746, is credited to Massachusetts. Maine ranks second, with a catch of 147,956,369 pounds, valued at \$3,889,035; Rhode Island third, with a catch of 48,250,883 pounds, valued at \$3,296,578; Connecticut fourth, with 23,652,647 pounds, valued at \$1,700,638; and New Hampshire fifth, with 528,730 pounds, valued at \$92,660.

The more important species taken in these States were: Cod, 84,917,535 pounds, valued at \$3,597,891; oysters, 19,337,374 pounds, or 2,762,482 bushels, valued at \$2,617,020; lobsters, 10,666,706 pounds, valued at \$2,550,980; haddock, 89,405,609 pounds, valued at \$2,544,617; and mackerel, 15,785,012 pounds, valued at \$1,562,088.

Compared with the Bureau's returns for 1905 there has been a decrease in the products of the fisheries of 12,943,734 pounds, or 2.70 per cent, in the quantity, and an increase of \$5,654,452, or 39.87 per cent, in the value. Compared with the returns of the Bureau of the Census for 1908 there has been a decrease in the products of 62,689,130 pounds, or 11.83 per cent, in the quantity and an increase of \$1,699,657, or 31.94 per cent, in the value. Compared with 1905 there was an increase in the quantity of products in Maine amounting to 23,232,583 pounds, or 18.62 per cent; in Rhode Island, of 24,354,640 pounds, or 101.92 per cent; but decreases in Connecticut of 51,320,001 pounds, or 68.45 per cent; in Massachusetts, of 8,703,231 pounds, or 3.40 per cent, and in New Hampshire of 507,722 pounds, or 48.99 per cent. In 1919 there was an increase in the value of the products in all of the States except Connecticut, as compared with 1905, as follows: Massachusetts, \$3,834,497, or 54.56 per cent; Rhode Island, \$1,749,920, or 113.14 per cent; Maine, \$1,502,629, or 62.96 per cent; and New Hampshire, \$40,716, or 78.38 per cent. In Connecticut the decrease in value amounted to \$1,473,310, or 46.42 per cent.

The following table gives the catch of certain species for various years from 1880 to 1919. These have been subdivided into groups

along the following general lines: (a) Species for which there have been relatively intensive fisheries and which on the basis of the returns reveal little indication of depletion of supply; (b) species showing signs of a depleted supply; and (c) species for which there has been an increasing demand and a sufficient supply to satisfy that demand.

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE NEW ENGLAND STATES,
VARIOUS YEARS, 1889 TO 1919.

| Year. | Cod. | Hake. | Mackerel. | Swordfish. | Clams, hard. |
|-----------|------------|------------|------------|------------|-----------------|
| 1889..... | 97,145,645 | 14,816,306 | 8,361,408 | 1,220,339 | 544,200 |
| 1898..... | 89,207,975 | 37,184,193 | 8,795,084 | 1,617,331 | 994,232 |
| 1902..... | 88,254,949 | 33,182,559 | 20,358,982 | 1,689,740 | 1,223,200 |
| 1905..... | 75,065,224 | 35,470,667 | 15,981,034 | 3,296,369 | 1,568,264 |
| 1908..... | 95,284,000 | 34,121,300 | 11,492,000 | 2,703,000 | 1,381,000 |
| 1919..... | 84,917,535 | 20,222,267 | 15,785,012 | 1,325,980 | 1,082,152 |

| Year. | Halibut. | Alewives. | Shad. | Lobster. | Clams, soft. |
|-----------|------------|-----------|-----------|------------|--------------|
| 1889..... | 10,740,843 | 7,882,682 | 1,334,714 | 30,449,603 | 11,542,272 |
| 1898..... | 10,828,187 | 6,985,948 | 1,415,649 | 14,661,808 | 11,296,901 |
| 1902..... | 12,365,705 | 8,437,446 | 1,380,812 | 14,756,495 | 8,345,470 |
| 1905..... | 3,017,776 | 8,743,284 | 1,260,904 | 11,524,499 | 6,375,850 |
| 1908..... | 4,353,500 | 7,581,000 | 1,285,500 | 14,734,000 | 7,294,000 |
| 1919..... | 1,960,030 | 3,782,289 | 939,995 | 10,666,707 | 4,992,874 |

| Year. | Haddock. | Pollock. | Herring. | Whiting. | Flounders. |
|-----------|------------|------------|-------------|------------|------------|
| 1889..... | 43,473,627 | 8,442,397 | 36,316,259 | 126,089 | 2,950,978 |
| 1898..... | 45,676,155 | 9,444,887 | 64,587,461 | 41,050 | 4,109,494 |
| 1902..... | 47,077,315 | 17,744,127 | 191,739,467 | 2,513,470 | 4,808,746 |
| 1905..... | 76,617,156 | 28,949,359 | 83,390,554 | 4,812,840 | 5,761,473 |
| 1908..... | 59,544,000 | 29,244,300 | 121,700,000 | 713,000 | 9,753,000 |
| 1919..... | 89,405,609 | 25,009,639 | 97,636,395 | 16,199,637 | 15,511,047 |

The following tables contain statistics of the number of persons employed, the amount of capital invested, the quantity and value of the products of the fisheries of the New England States in 1919, statistics of certain shellfish products in bushels and number, and comparative statistics of persons, investment, and products for various years from 1880 to 1919:

FISHERIES OF THE NEW ENGLAND STATES, 1919.

| Item. | Maine. | | New Hampshire. | | Massachusetts. | |
|------------------------------|---------|-------------|----------------|--------|----------------|-------------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| PERSONS ENGAGED. | | | | | | |
| On vessels fishing..... | 1,004 | ..... | ..... | ..... | 4,459 | ..... |
| On vessels transporting..... | 339 | ..... | 3 | ..... | 66 | ..... |
| In shore fisheries..... | 5,332 | ..... | 85 | ..... | 3,737 | ..... |
| Shoresmen..... | 7,711 | ..... | 12 | ..... | 4,084 | ..... |
| Total..... | 14,386 | ..... | 100 | ..... | 12,346 | ..... |
| INVESTMENT. | | | | | | |
| Vessels, fishing: | | | | | | |
| Steam..... | 5 | \$1,002,500 | ..... | ..... | 31 | \$2,484,545 |
| Tonnage..... | 662 | ..... | ..... | ..... | 3,316 | ..... |
| Outfit..... | ..... | 70,050 | ..... | ..... | ..... | 429,961 |
| Gasoline..... | 173 | 514,650 | ..... | ..... | 308 | 2,776,598 |
| Tonnage..... | 2,039 | ..... | ..... | ..... | 8,202 | ..... |
| Outfit..... | ..... | 91,013 | ..... | ..... | ..... | 1,059,438 |
| Sail..... | 4 | 53,000 | ..... | ..... | 51 | 808,315 |
| Tonnage..... | 392 | ..... | ..... | ..... | 4,734 | ..... |
| Outfit..... | ..... | 25,800 | ..... | ..... | ..... | 352,312 |

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

| Item. | Maine. | | New Hampshire. | | Massachusetts. | |
|---------------------------------------|------------|------------|----------------|---------|----------------|------------|
| INVESTMENT—continued. | | | | | | |
| Vessels transporting: | Number. | Value. | Number. | Value. | Number. | Value. |
| Steam..... | 2 | \$9,000 | | | | |
| Tonnage..... | 28 | | | | | |
| Outfit..... | | 2,800 | | | | |
| Gasoline..... | 165 | 510,010 | 1 | \$6,300 | 22 | \$108,950 |
| Tonnage..... | 1,762 | | 8 | | 460 | |
| Outfit..... | | 103,998 | | 3,000 | | 16,680 |
| Sail..... | 2 | 16,713 | | | 3 | 13,800 |
| Tonnage..... | 121 | | | | 132 | |
| Outfit..... | | 6,375 | | | | 2,375 |
| Boats: | | | | | | |
| Sail, row, etc..... | 2,759 | \$3,639 | 31 | \$82 | 1,308 | 58,488 |
| Power..... | 3,090 | 902,080 | 53 | 10,675 | 1,732 | 891,195 |
| Apparatus, vessel fisheries: | | | | | | |
| Seines..... | 81 | 93,270 | | | 100 | 193,850 |
| Gill nets..... | 1,253 | 29,689 | | | 5,430 | 107,685 |
| Otter trawls..... | 13 | 2,520 | | | 119 | 17,850 |
| Lines, hand and trawl..... | | 31,747 | | | | 133,658 |
| Harpoons..... | | 2,230 | | | | 6,655 |
| Lobster pots..... | 1,085 | 2,195 | | | 430 | 1,050 |
| Dredges..... | 4 | 400 | | | 224 | 2,516 |
| Tongs and rakes..... | | | | | 3 | 49 |
| Whaling apparatus..... | | | | | | 29,000 |
| Apparatus, shore fisheries: | | | | | | |
| Seines..... | 103 | 44,055 | | | 67 | 46,045 |
| Gill nets..... | 2,786 | 71,214 | | | 3,688 | 77,323 |
| Pound nets, trap nets, and weirs..... | 690 | 514,665 | | | 254 | 387,470 |
| Fek nets..... | 116 | 3,385 | | | 53 | 1,585 |
| Bag nets and pocket nets..... | 95 | 8,675 | | | | |
| Bow nets..... | | | | | 13 | 36 |
| Dip nets and scoop nets..... | 102 | 776 | | | 104 | 374 |
| Otter trawls..... | 39 | 1,635 | | | 191 | 9,510 |
| Lines, hand and trawl..... | | 61,410 | | 462 | | 51,412 |
| Harpoons..... | | 215 | | | | 540 |
| Spears..... | 42 | 57 | | | 72 | 171 |
| Cunner traps..... | 80 | 140 | | | 4 | 6 |
| Eel pots and traps..... | 599 | 1,198 | 18 | 36 | 1,826 | 4,455 |
| Lobster pots..... | 153,532 | 382,258 | 2,275 | 6,735 | 43,012 | 109,359 |
| Crabs traps..... | 180 | 330 | | | | |
| Dredges..... | 24 | 2,500 | | | 2,761 | 16,521 |
| Tongs and grabs..... | | | | | 235 | 1,355 |
| Rakes..... | | | | 12 | 784 | 5,656 |
| Forks and hoes..... | 1,105 | 1,067 | 25 | 50 | 75 | 887 |
| Cockle traps..... | | | | | 680 | 500 |
| Shore and accessory property..... | | 11,864,571 | | 11,658 | | 7,000,239 |
| Cash capital..... | | 1,029,707 | | 5,500 | | 1,902,915 |
| Total..... | | 17,594,969 | | 45,530 | | 11,114,269 |
| PRODUCTS. | | | | | | |
| Alwefives: | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Fresh..... | 580,811 | \$7,455 | | | 1,097,476 | \$23,070 |
| Salted..... | 6,860 | 176 | | | 1,259,131 | 55,995 |
| Smoked..... | 352,293 | 10,606 | | | 39,000 | 2,815 |
| Bluefish..... | 39 | 7 | | | 4,721 | 791 |
| Bonito..... | 44 | 4 | | | 189,727 | 18,016 |
| Butterfish..... | 32,763 | 3,031 | | | 296,828 | 26,810 |
| Cod: | | | | | | |
| Fresh..... | 13,095,145 | 479,827 | 98,354 | \$3,609 | 66,320,920 | 2,826,091 |
| Salted..... | 983,244 | 62,312 | | | 3,175,405 | 166,702 |
| Cunner..... | 30,695 | 615 | | | 9,959 | 585 |
| Cusk: | | | | | | |
| Fresh..... | 1,046,147 | 33,580 | 2,400 | 86 | 1,561,337 | 55,068 |
| Salted..... | | | | | 16,870 | 759 |
| Halibut..... | 305,050 | 25,249 | 2,000 | 240 | 374,167 | 47,714 |
| Flounder..... | 493,204 | 22,227 | 8,000 | 240 | 10,262,693 | 478,850 |
| Crabs..... | | | | | 63,667 | 184 |
| Greenfish or monkfish..... | | | | | 2,500 | 7 |
| Haddock: | | | | | | |
| Fresh..... | 11,124,411 | 332,215 | 18,764 | 829 | 77,804,810 | 2,191,215 |
| Salted..... | 73,400 | 2,812 | | | 373,574 | 16,996 |
| Hake: | | | | | | |
| Fresh..... | 16,108,575 | 329,227 | 3,000 | 98 | 4,066,437 | 156,353 |
| Salted..... | 5,060 | 256 | | | 29,095 | 1,307 |
| Halibut: | | | | | | |
| Fresh..... | 217,476 | 31,841 | | | 1,708,509 | 296,232 |
| Salted..... | 1,000 | 80 | | | 8,045 | 1,660 |
| Herring: | | | | | | |
| Fresh..... | 89,646,126 | 455,604 | | | 10,811,409 | 129,408 |
| Salted..... | 6,200 | 187 | | | | |
| Smoked..... | 161,550 | 6,715 | | | | |

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

| Item. | Maine. | | New Hampshire. | | Massachusetts. | |
|--------------------------|-------------|-----------|----------------|--------|----------------|------------|
| PRODUCTS—continued. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Hickory shad..... | | | | | 12,800 | \$830 |
| King whiting..... | | | | | 72 | 18 |
| Laurel..... | | | | | 67,800 | 838 |
| Mackerel: | | | | | | |
| Fresh..... | 593,506 | \$81,428 | | | 12,267,132 | 1,212,461 |
| Salted..... | 8,000 | 650 | | | 1,219,062 | 109,948 |
| Frigate..... | | | | | 61,361 | 1,862 |
| Menhaden..... | | | | | 161,219 | 2,231 |
| Minnows..... | | | | | 1,000 | 125 |
| Perch: | | | | | | |
| White..... | | | | | 6,200 | 920 |
| Yellow..... | | | | | 500 | 25 |
| Pollock: | | | | | | |
| Fresh..... | 5,597,163 | 113,487 | 25,600 | \$615 | 19,192,388 | 468,169 |
| Salted..... | 34,500 | 2,440 | | | 50,153 | 1,774 |
| Pompano..... | | | | | 14 | 2 |
| Rosefish..... | 17,322 | 245 | | | 36,773 | 1,121 |
| Round herring..... | | | | | 941 | 19 |
| Salmon: | | | | | | |
| Atlantic..... | 20,610 | 7,926 | | | | |
| Humpback..... | 310 | 62 | | | | |
| Sculpin..... | | | | | 6,000 | 15 |
| Scup..... | | | | | 78,624 | 5,666 |
| Sea bass..... | | | | | 15,067 | 1,649 |
| Sea robin..... | | | | | 400 | 1 |
| Shad..... | 414,455 | 28,393 | | | 62,337 | 4,309 |
| Sharks..... | 39,747 | 884 | | | 328,399 | 3,664 |
| Skates and rays..... | 2,385 | 47 | | | 100,354 | 503 |
| Smelt..... | 523,967 | 94,496 | | | 39,150 | 10,690 |
| Squeteague..... | | | | | 5,777 | 908 |
| Striped bass..... | 592 | 113 | | | 5,971 | 231 |
| Sturgeon..... | 8,129 | 1,714 | | | 12,098 | 3,358 |
| Sturgeon caviar..... | | | | | 150 | 356 |
| Sturgeon roe..... | 143 | 297 | | | 181 | 163 |
| Suckers..... | 110,400 | 11,852 | | | | |
| Swordfish..... | 424,813 | 104,734 | | | 711,729 | 155,350 |
| Tanog..... | 14 | 2 | | | 91,876 | 8,885 |
| Tilefish..... | | | | | 188,180 | 9,803 |
| Tomcod..... | 147,160 | 4,511 | | | 7,890 | 239 |
| Tuna..... | 31,909 | 2,040 | | | 42,901 | 3,548 |
| Whiting: | | | | | | |
| Fresh..... | 684,970 | 4,727 | | | 13,918,650 | 148,854 |
| Salted..... | 3,000 | 90 | | | | |
| Wolfish..... | 83,958 | 2,061 | | | 291,188 | 9,219 |
| Other fish..... | | | | | 38,232 | 2,117 |
| Lobster..... | 5,545,884 | 1,411,548 | 298,012 | 73,203 | 2,387,636 | 516,393 |
| Shrimp..... | | | | | 3,400 | 1,589 |
| Crabs: | | | | | | |
| Hard..... | 70,575 | 3,595 | | | 1,764,961 | 49,424 |
| Soft..... | | | | | 266 | 40 |
| Squid..... | 377 | 4 | | | 6,134,557 | 108,864 |
| Clams: | | | | | | |
| Hard— | | | | | | |
| Public..... | | | | | 853,304 | 271,342 |
| Private..... | | | | | 22,640 | 12,425 |
| Soft— | | | | | | |
| Public..... | 2,105,734 | 163,209 | 66,600 | 13,320 | 2,062,630 | 232,194 |
| Private..... | | | | | 125,000 | 10,750 |
| Razor..... | | | | | 23,300 | 3,500 |
| Oysters: | | | | | | |
| Market— | | | | | | |
| Public..... | | | | | 5,579 | 1,383 |
| Private..... | | | | | 769,055 | 278,164 |
| Seed— | | | | | | |
| Public..... | | | | | 23,100 | 1,320 |
| Private..... | | | | | 80,178 | 6,552 |
| Scallops..... | 72,512 | 31,416 | | | 1,332,486 | 439,382 |
| Mussels..... | 16,970 | 367 | | | | |
| Cockles and winkles..... | | | | | 577,400 | 3,425 |
| Blackfish..... | | | | | 40,000 | 40 |
| Porpoise..... | | | | | 750 | 15 |
| Livers..... | 112,587 | 1,712 | | | 313,575 | 4,844 |
| Spawn..... | 18,857 | 778 | | | 146,929 | 8,836 |
| Tongues and cheeks..... | 5,200 | 190 | | | 600 | 12 |
| Sounds..... | 5,212 | 96 | | | | |
| Oil: | | | | | | |
| Sperm..... | | | | | 1,545,413 | 218,111 |
| Liver..... | 8,625 | 895 | | | | |
| Ambergris..... | | | | | 30 | 5,000 |
| Alcawife-seals..... | | | | | 10,400 | 5,200 |
| Irish moss..... | | | 6,000 | 420 | 204,200 | 15,027 |
| Total..... | 147,956,369 | 3,889,035 | 528,730 | 92,660 | 246,951,241 | 10,859,746 |

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

| Item. | Rhode Island. | | Connecticut. | | Total. | |
|---------------------------------------|---------------|-----------|--------------|-----------|---------|-------------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 317 | | 566 | | 6,346 | |
| On vessels transporting..... | 44 | | 81 | | 533 | |
| In shore fisheries..... | 795 | | 1,019 | | 10,968 | |
| Shoresmen..... | 490 | | 623 | | 12,920 | |
| Total..... | 1,646 | | 2,289 | | 30,767 | |
| INVESTMENT. | | | | | | |
| Vessels, fishing: | | | | | | |
| Steam..... | 9 | \$141,000 | 24 | \$328,243 | 72 | \$3,956,288 |
| Tonnage..... | 564 | | 2,240 | | 6,776 | |
| Outfit..... | | 51,910 | | 135,346 | | 687,267 |
| Gasoline..... | 55 | 199,400 | 67 | 189,425 | 603 | 3,670,983 |
| Tonnage..... | 849 | | 924 | | 12,014 | |
| Outfit..... | | 82,025 | | 94,660 | | 1,327,166 |
| Sail..... | 2 | | 24 | 12,495 | 82 | 873,810 |
| Tonnage..... | | | 183 | | 5,309 | |
| Outfit..... | | | | 7,955 | | 386,067 |
| Vessels transporting: | | | | | | |
| Steam..... | 5 | 22,000 | 2 | 13,200 | 9 | 44,206 |
| Tonnage..... | 77 | | 111 | | 216 | |
| Outfit..... | | 27,800 | | 9,627 | | 36,227 |
| Gasoline..... | 13 | 29,260 | 4 | 7,800 | 205 | 662,290 |
| Tonnage..... | 164 | | 95 | | 2,429 | |
| Outfit..... | | 10,500 | | 4,370 | | 138,548 |
| Sail..... | | | | | 5 | 30,515 |
| Tonnage..... | | | | | 253 | |
| Outfit..... | | | | | | 8,750 |
| Barge..... | | | 2 | 4,000 | 2 | 4,000 |
| Tonnage..... | | | 316 | | 316 | |
| Outfit..... | | | | 1,900 | | 1,900 |
| Boats: | | | | | | |
| Sail, row, etc..... | 196 | 4,503 | 399 | 9,670 | 4,693 | 157,102 |
| Power..... | 432 | 182,780 | 364 | 136,881 | 5,671 | 2,123,611 |
| Apparatus, vessel fisheries: | | | | | | |
| Seines..... | 18 | 24,695 | 4 | 7,800 | 206 | 319,615 |
| Gill nets..... | 780 | 14,445 | 115 | 2,680 | 7,578 | 154,499 |
| Pound nets..... | 25 | 75,000 | | | 25 | 75,000 |
| Other trawls..... | 20 | 973 | 14 | 680 | 166 | 22,023 |
| Lines, hand and trawl..... | | 785 | | 555 | | 169,745 |
| Harpoons..... | | 561 | | 600 | | 10,046 |
| Lobster pots..... | 635 | 1,985 | 480 | 745 | 2,630 | 5,975 |
| Dredges..... | 48 | 2,092 | 372 | 8,437 | 648 | 13,145 |
| Tongs and rakes..... | | | | | 3 | 49 |
| Whaling apparatus..... | | | | | | 29,000 |
| Apparatus, shore fisheries: | | | | | | |
| Seines..... | 11 | 899 | 54 | 4,893 | 235 | 95,892 |
| Gill nets..... | 360 | 7,300 | 204 | 13,910 | 7,038 | 169,747 |
| Pound nets, trap nets, and weirs..... | 108 | 101,750 | 42 | 9,112 | 1,094 | 1,012,997 |
| Fyke nets..... | 290 | 5,218 | 439 | 3,985 | 928 | 14,473 |
| Bag nets and pocket nets..... | | | | | 95 | 8,675 |
| Bow nets..... | | | | | 13 | 36 |
| Dip nets and scoop nets..... | 30 | 450 | 7 | 35 | 243 | 1,635 |
| Other trawls..... | 43 | 2,425 | 53 | 2,394 | 326 | 15,964 |
| Lines, hand and trawl..... | | 4,492 | | 58 | | 117,834 |
| Harpoons..... | | 690 | | 80 | | 1,525 |
| Spears..... | | | 30 | 39 | 144 | 267 |
| Cunner traps..... | | | | | 84 | 146 |
| Eel pots and traps..... | 995 | 1,035 | 801 | 617 | 4,239 | 7,341 |
| Lobster pots..... | 21,936 | 65,346 | 16,173 | 42,534 | 236,928 | 606,232 |
| Crab traps..... | | | | | 180 | 330 |
| Dredges..... | 201 | 1,119 | 55 | 395 | 3,044 | 20,535 |
| Tongs and grabs..... | 247 | 1,990 | 244 | 1,994 | 726 | 5,348 |
| Rakes..... | 29 | 166 | 61 | 367 | 876 | 6,201 |
| Forks and hoes..... | 152 | 148 | 68 | 69 | 1,823 | 2,321 |
| Shovels..... | 43 | 43 | 13 | 13 | 56 | 56 |
| Cockle traps..... | | | | | 680 | 500 |
| Winkle pots..... | 260 | 850 | | | 260 | 880 |
| Shore and accessory property..... | | 978,622 | | 498,699 | | 20,354,089 |
| Cash capital..... | | 200,300 | | 98,500 | | 3,245,952 |
| Total..... | | 2,249,536 | | 1,645,793 | | 40,597,097 |

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

| Item. | Rhode Island. | | Connecticut. | | Total. | |
|----------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| PRODUCTS. | | | | | | |
| Alewives: | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Fresh..... | 269,565 | \$5,916 | 177,150 | \$6,637 | 2,125,002 | \$13,078 |
| Salted..... | | | | | 1,265,994 | 56,171 |
| Smoked..... | | | | | 391,293 | 22,451 |
| Bluefish..... | 25,675 | 3,170 | 3,710 | 386 | 34,145 | 1,311 |
| Bonito..... | 114,810 | 10,825 | 6,120 | 912 | 310,701 | 29,759 |
| Bullheads..... | | | 1,492 | 100 | 1,492 | 100 |
| Butterfish..... | 758,845 | 39,188 | 18,810 | 2,607 | 1,107,246 | 71,636 |
| Carp..... | | | 40,141 | 4,922 | 40,141 | 4,922 |
| Cod: | | | | | | |
| Fresh..... | 1,148,331 | 49,747 | 96,136 | 9,603 | 80,758,886 | 3,368,877 |
| Salted..... | | | | | 4,158,649 | 229,014 |
| Cunner..... | 8,000 | 960 | | | 48,654 | 2,160 |
| Cusk: | | | | | | |
| Fresh..... | | | 6,767 | 73 | 2,616,651 | 88,807 |
| Salted..... | | | | | 16,870 | 759 |
| Eels..... | 274,735 | 29,637 | 63,046 | 9,839 | 1,018,988 | 112,679 |
| Flounders..... | 2,451,579 | 79,567 | 2,349,181 | 91,962 | 15,541,047 | 672,846 |
| Grayfish..... | | | | | 63,667 | 184 |
| Goosefish or monkfish..... | | | | | 2,500 | 7 |
| Haddock: | | | | | | |
| Fresh..... | 10,300 | 512 | 350 | 38 | 88,958,635 | 2,524,800 |
| Salted..... | | | | | 446,974 | 19,808 |
| Hake: | | | | | | |
| Fresh..... | | | 10,100 | 102 | 20,188,112 | 485,780 |
| Salted..... | | | | | 34,155 | 1,563 |
| Halibut: | | | | | | |
| Fresh..... | | | 25,000 | 5,000 | 1,950,985 | 333,073 |
| Salted..... | | | | | 9,045 | 1,140 |
| Herring: | | | | | | |
| Fresh..... | 169,660 | 4,010 | 3,000 | 71 | 97,630,195 | 589,093 |
| Salted..... | | | | | 6,200 | 187 |
| Smoked..... | | | | | 161,550 | 6,715 |
| Hickory shad..... | | | | | 12,800 | 830 |
| King whiting..... | | | | | 72 | 18 |
| Lance..... | | | | | 67,800 | 838 |
| Mackerel: | | | | | | |
| Fresh..... | 1,575,923 | 146,611 | 91,389 | 10,990 | 14,527,950 | 1,451,490 |
| Salted..... | | | | | 1,257,062 | 110,598 |
| Frigate..... | | | | | 61,361 | 1,862 |
| Menhaden..... | 21,536,000 | 268,700 | 6,736,564 | 93,312 | 28,433,783 | 361,213 |
| Minnnows..... | | | | | 1,000 | 125 |
| Perch: | | | | | | |
| White..... | 5,043 | 702 | | | 11,243 | 1,622 |
| Yellow..... | | | 6,108 | 595 | 6,608 | 620 |
| Pickrel..... | | | 1,079 | 143 | 1,079 | 143 |
| Pollock: | | | | | | |
| Fresh..... | 99,400 | 5,920 | 10,135 | 717 | 24,924,686 | 588,908 |
| Salted..... | | | | | 81,953 | 4,214 |
| Pompano..... | | | | | 14 | 2 |
| Rosefish..... | | | | | 54,095 | 1,369 |
| Round herring..... | | | | | 941 | 19 |
| Salmon: | | | | | | |
| Atlantic..... | 70 | 12 | | | 20,680 | 7,938 |
| Humpback..... | | | | | 310 | 62 |
| Sculpin..... | | | | | 6,000 | 15 |
| Scup..... | 8,261,140 | 817,846 | 1,980 | 202 | 8,341,744 | 823,714 |
| Sea bass..... | 52,011 | 5,954 | 3,555 | 528 | 70,663 | 8,131 |
| Sea robin..... | | | | | 400 | 1 |
| Shad..... | | | 463,203 | 86,637 | 939,995 | 119,339 |
| Sharks..... | | | | | 368,146 | 4,548 |
| Skates and rays..... | | | 400 | 10 | 103,139 | 5,500 |
| Smelt..... | | | 25,217 | 4,466 | 588,334 | 109,652 |
| Squeteague..... | 353,860 | 33,829 | 23,076 | 3,257 | 382,713 | 37,994 |
| Striped bass..... | 33,705 | 5,236 | 4,810 | 1,059 | 40,078 | 6,639 |
| Sturgeon..... | | | 25 | 5 | 20,252 | 5,077 |
| Sturgeon caviar..... | | | | | 150 | 356 |
| Sturgeon roe..... | | | | | 321 | 460 |
| Suckers..... | | | 99,073 | 7,188 | 209,453 | 19,340 |
| Sunfish..... | | | 105 | 11 | 105 | 11 |
| Swordfish..... | 101,010 | 19,757 | 88,428 | 15,006 | 1,325,980 | 294,827 |
| Tautog..... | 371,660 | 22,191 | 21,942 | 2,068 | 485,492 | 33,146 |
| Tilfish..... | | | | | 188,180 | 9,803 |
| Tomcod..... | | | 455 | 37 | 155,505 | 4,787 |
| Tuna..... | 61,350 | 4,810 | 5,114 | 550 | 141,274 | 10,948 |
| Whiting: | | | | | | |
| Fresh..... | 1,583,700 | 16,010 | 9,317 | 175 | 16,196,637 | 169,766 |
| Salted..... | | | | | 3,000 | 90 |
| Wolfish..... | | | | | 375,146 | 11,280 |
| Other fish..... | | | | | 38,232 | 2,117 |
| Lobster..... | 1,694,327 | 360,679 | 740,848 | 189,157 | 10,666,707 | 2,550,980 |

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

| Item. | Rhode Island. | | Connecticut. | | Total. | |
|--------------------------|---------------|-----------|--------------|-----------|-------------|------------|
| PRODUCTS—continued. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Shrimp..... | | | | | 3,400 | \$1,589 |
| Crabs: | | | | | | |
| Hard..... | 31,330 | \$1,892 | | | 1,899,866 | 51,821 |
| Soft..... | | | | | 266 | 40 |
| Squid..... | 577,579 | 18,730 | 3,612 | \$258 | 6,516,125 | 127,856 |
| Clams: | | | | | | |
| Hard— | | | | | | |
| Public..... | 156,232 | 50,649 | 49,976 | 18,912 | 1,059,512 | 349,903 |
| Private..... | | | | | 22,610 | 12,425 |
| Soft— | | | | | | |
| Public..... | 493,760 | 21,075 | 229,150 | 22,070 | 4,867,874 | 461,868 |
| Private..... | | | | | 125,000 | 10,750 |
| Razor..... | | | | | 23,300 | 3,500 |
| Oysters: | | | | | | |
| Market— | | | | | | |
| Public..... | | | 136,654 | 21,900 | 142,233 | 23,283 |
| Private..... | | | 4,826,668 | 471,766 | 11,857,182 | 1,992,515 |
| Seed..... | 6,261,759 | 1,242,585 | | | | |
| Public..... | | | 740,516 | 68,349 | 763,616 | 69,669 |
| Private..... | | | 6,493,865 | 525,001 | 6,574,043 | 531,533 |
| Scallops..... | 33,994 | 14,698 | 38,400 | 13,717 | 1,477,392 | 499,123 |
| Mussels..... | 10,000 | 1,000 | | | 26,970 | 1,267 |
| Cockles and winkles..... | 10,500 | 2,100 | | | 587,900 | 5,325 |
| Blackfish..... | | | | | 40,000 | 40 |
| Porpoise..... | | | | | 750 | 15 |
| Livers..... | | | | | 426,162 | 6,556 |
| Spawn..... | | | | | 165,786 | 9,614 |
| Tongues and cheeks..... | | | | | 5,800 | 202 |
| Sounds..... | | | | | 5,212 | 96 |
| Oil: | | | | | | |
| Sperm..... | | | | | 1,545,413 | 218,111 |
| Liver..... | | | | | 8,625 | 895 |
| Ambergris..... | | | | | 30 | 5,000 |
| Alewife scales..... | | | | | 10,400 | 5,200 |
| Irish moss..... | 2,000 | 240 | | | 212,200 | 15,687 |
| Total..... | 48,250,883 | 3,296,578 | 23,652,647 | 1,799,638 | 467,339,579 | 19,845,657 |

CERTAIN OF THE FOREGOING SHELLFISH PRODUCTS IN BUSHELS AND NUMBER.

| Products. | Maine. | | New Hampshire. | | Massachusetts. | |
|----------------------|-----------|-----------|----------------|----------|----------------|-----------|
| | Quantity. | Value. | Quantity. | Value. | Quantity. | Value. |
| Clams: | | | | | | |
| Hard (quahogs)— | | | | | | |
| Public.....bushels.. | | | | | 106,663 | \$271,342 |
| Private.....do..... | | | | | 2,830 | 12,425 |
| Soft— | | | | | | |
| Public.....do..... | 210,573 | \$163,209 | 6,660 | \$13,320 | 206,263 | 232,194 |
| Private.....do..... | | | | | 12,500 | 10,750 |
| Razor.....do..... | | | | | 2,330 | 3,500 |
| Oysters: | | | | | | |
| Market— | | | | | | |
| Public.....do..... | | | | | 797 | 1,383 |
| Private.....do..... | | | | | 199,865 | 278,164 |
| Seed— | | | | | | |
| Public.....do..... | | | | | 3,300 | 1,320 |
| Private.....do..... | | | | | 11,451 | 6,552 |
| Scallops.....do..... | 12,085 | 31,416 | | | 222,081 | 439,382 |
| Mussels.....do..... | 1,697 | 367 | | | | |
| Cockles.....do..... | | | | | 57,740 | 3,425 |
| Crabs: | | | | | | |
| Hard.....number..... | 211,725 | 3,595 | | | 5,294,883 | 49,424 |
| Soft.....do..... | | | | | 798 | 40 |

CERTAIN OF THE FOREGOING SHELLFISH PRODUCTS IN BUSHELS AND NUMBER—
Continued.

| Products. | Rhode Island. | | Connecticut. | | Total. | |
|----------------------|---------------|-----------|--------------|----------|-----------|-----------|
| | Quantity. | Value. | Quantity. | Value. | Quantity. | Value. |
| Clams: | | | | | | |
| Hard (quahogs)— | | | | | | |
| Public.....bushels.. | 19,529 | \$39,649 | 6,247 | \$18,912 | 132,439 | \$349,903 |
| Private.....do..... | | | | | 2,830 | 12,425 |
| Soft.....do..... | | | | | | |
| Public.....do..... | 49,373 | 24,075 | 22,915 | 32,070 | 486,787 | 464,868 |
| Private.....do..... | | | | | 12,500 | 10,750 |
| Razor.....do..... | | | | | 2,330 | 3,500 |
| Oysters: | | | | | | |
| Market— | | | | | | |
| Public.....do..... | | | 19,522 | 21,990 | 20,319 | 23,283 |
| Private.....do..... | 894,537 | 1,242,585 | 689,524 | 471,766 | 1,693,926 | 1,992,515 |
| Seed— | | | | | | |
| Public.....do..... | | | 105,788 | 68,349 | 109,088 | 60,669 |
| Private.....do..... | | | 927,695 | 525,001 | 939,149 | 531,553 |
| Scallops.....do..... | 5,666 | 14,608 | 6,400 | 13,717 | 246,232 | 499,123 |
| Mussels.....do..... | 1,030 | 1,030 | | | 2,697 | 1,367 |
| Cockles.....do..... | | | | | 57,740 | 3,425 |
| Winkles.....do..... | 1,050 | 2,100 | | | 1,050 | 2,100 |
| Crabs: | | | | | | |
| Hard.....number..... | | | | | 5,506,608 | 53,019 |
| Soft.....do..... | | | | | 798 | 40 |

EXTENT OF FISHERIES OF NEW ENGLAND STATES, VARIOUS YEARS, 1880 TO 1919.¹

| Item. | 1880 | 1887 | 1888 | 1889 |
|--------------------|-------------|-------------|-------------|-------------|
| PERSONS ENGAGED. | | | | |
| Maine..... | 11,071 | 15,323 | 15,171 | 14,129 |
| New Hampshire..... | 414 | 346 | 362 | 365 |
| Massachusetts..... | 20,117 | 17,053 | 17,037 | 17,238 |
| Rhode Island..... | 2,310 | 1,635 | 1,703 | 1,757 |
| Connecticut..... | 3,131 | 3,024 | 3,037 | 3,047 |
| Total..... | 37,043 | 37,381 | 37,310 | 36,536 |
| INVESTMENT. | | | | |
| Maine..... | \$3,341,344 | \$3,179,233 | \$3,023,921 | \$2,889,593 |
| New Hampshire..... | 209,465 | 106,110 | 107,144 | 112,660 |
| Massachusetts..... | 14,334,450 | 13,205,050 | 13,110,765 | 13,245,229 |
| Rhode Island..... | 596,678 | 992,761 | 1,022,576 | 1,020,178 |
| Connecticut..... | 1,421,020 | 2,897,687 | 2,869,314 | 2,826,834 |
| Total..... | 19,902,957 | 20,380,841 | 20,134,020 | 20,094,794 |
| PRODUCTS | | | | |
| Pounds: | | | | |
| Maine..... | | 131,379,591 | 132,920,594 | 129,559,864 |
| New Hampshire..... | | 4,254,727 | 3,813,479 | 4,354,568 |
| Massachusetts..... | | 299,544,343 | 302,045,686 | 299,217,669 |
| Rhode Island..... | | 45,284,872 | 91,687,487 | 127,365,475 |
| Connecticut..... | | 39,750,008 | 42,401,612 | 92,672,464 |
| Total..... | | 520,213,541 | 572,907,858 | 653,170,040 |
| Value: | | | | |
| Maine..... | \$2,742,571 | \$2,364,906 | \$2,292,043 | \$2,111,206 |
| New Hampshire..... | 170,634 | 99,460 | 90,044 | 88,511 |
| Massachusetts..... | 7,959,760 | 6,464,396 | 6,355,495 | 5,858,274 |
| Rhode Island..... | 696,814 | 683,495 | 825,092 | 935,144 |
| Connecticut..... | 933,242 | 300,746 | 297,337 | 1,557,506 |
| Total..... | 12,503,021 | 9,913,003 | 9,860,011 | 10,550,641 |

¹ The statistics for 1908 are from data published by the Bureau of the Census.

EXTENT OF FISHERIES OF NEW ENGLAND STATES, VARIOUS YEARS, 1880 TO 1919—
Continued.

| Item. | 1898 | 1902 | 1905 | 1908 | 1919 |
|-------------------------|-------------|-------------|-------------|-------------|--------------|
| PERSONS ENGAGED. | | | | | |
| Maine..... | 16,954 | 19,832 | 15,881 | 6,861 | 14,386 |
| New Hampshire..... | 154 | 161 | 145 | 79 | 100 |
| Massachusetts..... | 14,363 | 14,300 | 15,694 | 11,577 | 12,346 |
| Rhode Island..... | 1,687 | 2,117 | 2,212 | 1,493 | 1,646 |
| Connecticut..... | 2,473 | 2,840 | 3,407 | 2,147 | 2,289 |
| Total..... | 35,631 | 39,250 | 37,339 | 22,157 | 30,767 |
| INVESTMENT. | | | | | |
| Maine..... | \$4,013,053 | \$6,939,503 | \$8,972,049 | \$2,411,000 | \$17,544,969 |
| New Hampshire..... | 52,648 | 42,002 | 47,050 | 23,000 | 45,530 |
| Massachusetts..... | 13,372,902 | 10,811,594 | 10,810,442 | 5,750,000 | 19,111,269 |
| Rhode Island..... | 957,142 | 1,014,280 | 1,005,423 | 1,504,000 | 2,249,488 |
| Connecticut..... | 1,241,294 | 1,201,655 | 1,635,753 | 2,281,000 | 1,645,793 |
| Total..... | 19,637,036 | 20,008,434 | 22,530,720 | 11,969,000 | 40,537,049 |
| PRODUCTS. | | | | | |
| Maine..... | 123,404,561 | 242,390,371 | 121,723,789 | 173,843,090 | 147,956,369 |
| New Hampshire..... | 3,020,715 | 1,593,013 | 1,036,452 | 677,000 | 528,730 |
| Massachusetts..... | 202,257,817 | 230,645,950 | 255,654,475 | 244,313,000 | 246,951,241 |
| Rhode Island..... | 32,854,396 | 21,613,964 | 23,896,243 | 44,254,000 | 48,250,883 |
| Connecticut..... | 31,920,417 | 37,832,149 | 74,972,648 | 66,942,000 | 23,652,647 |
| Total..... | 393,457,906 | 534,075,417 | 480,283,604 | 530,029,090 | 470,995,169 |
| Value: | | | | | |
| Maine..... | \$2,654,919 | \$2,918,772 | \$2,386,406 | \$3,257,000 | \$3,889,035 |
| New Hampshire..... | 48,987 | 50,003 | 51,944 | 53,000 | 92,060 |
| Massachusetts..... | 4,463,727 | 6,482,427 | 7,025,249 | 7,095,000 | 10,869,546 |
| Rhode Island..... | 955,058 | 1,155,701 | 1,546,658 | 1,752,000 | 3,296,778 |
| Connecticut..... | 1,559,599 | 1,799,381 | 3,173,948 | 2,982,090 | 1,700,638 |
| Total..... | 9,682,290 | 12,406,284 | 14,184,205 | 15,139,090 | 19,887,406 |

BY-PRODUCTS.

Only a few firms are engaged solely in the preparation of by-products in the New England States and several of these are the sole manufacturers of a particular product within the State or section, the greater part of the material being prepared incidental to other branches of the fishery trade. It is therefore impracticable to present a detailed table of this important industry for individual States. In the following table the quantity and value of the products are shown as completely as possible without disclosing private enterprise.

In view of the increased demand for protein feed for hogs, cattle, and poultry, it is suggested that New England producers of scrap and pomace give consideration to the manufacture of fish waste and waste fish into fish meal for feeding purposes.

QUANTITY AND VALUE OF VARIOUS FISHERY BY-PRODUCTS PREPARED IN NEW ENGLAND IN 1919.

| Item. | Maine. | | Massachusetts. | | Total. | |
|----------------------------------|---------------------|-----------|----------------------|-----------|----------------------|-----------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| Oil: | | | | | | |
| Liver.....gallons.. | ¹ 97,077 | \$106,363 | 158,797 | \$180,635 | ² 255,874 | \$286,998 |
| Herring.....do. | 23,861 | 14,569 | | | 23,861 | 14,569 |
| Sperm.....do. | | | 206,055 | 218,111 | ³ 206,055 | 218,111 |
| Liquid glue.....do. | 35,658 | 51,582 | ⁴ 388,352 | 571,924 | 424,010 | 599,567 |
| Fish scrap and meal.....pounds.. | 4,115,200 | 130,461 | 6,291,997 | 140,570 | 10,407,197 | 271,031 |
| Herring pomace.....do. | 1,271,424 | 16,411 | | | 1,271,424 | 16,411 |
| Other.....do. | | | | | | 232,135 |
| Total..... | | 302,387 | | 1,014,235 | | 1,649,762 |

¹ Includes a small quantity made in New Hampshire.

² Of this amount, 1,150 gallons, or 8,625 pounds, valued at \$895, were produced by fishermen.

³ All produced by fishermen.

⁴ Includes a small quantity of dry glue.

⁵ Includes value of oyster shell grit made in Rhode Island and menhaden oil, dry scrap, and acidulated scrap made in Connecticut.

FISHERIES OF MAINE.

Maine ranks first among the New England States in the number of persons engaged in the fisheries and related industries, but is surpassed by Massachusetts in the amount of capital invested and the quantity and value of fishery products. In 1919 the number of persons engaged in the various branches of the fishery industry in Maine was 14,386, of whom 1,004 were on vessels fishing, 339 on vessels transporting fishery products, 5,332 in the shore or boat fisheries, and 7,711 in the wholesale fishery trade, canning sardines, and other fishery industries.

The amount of capital invested amounted to \$17,544,969, which includes 351 fishing and transporting vessels, valued at \$2,105,905, with a net tonnage of 5,004 tons and outfits valued at \$300,036; 5,819 power, sail, row, and other small boats, valued at \$985,719; fishing apparatus to the value of \$1,259,031, of which gear to the value of \$165,051 was employed in the vessel fisheries and gear to the value of \$1,093,980 on boats; shore and accessory property to the value of \$11,864,571; and cash or working capital to the amount of \$1,029,707.

The products of the fisheries amounted to 147,956,369 pounds, valued at \$3,889,035. This represents 31.65 per cent of the total quantity and 19.60 per cent of the total value of the products of the fisheries of the New England States in 1919. Compared with 1905 there was an increase of 18.62 per cent in quantity and 62.96 per cent in value to the fishermen. Compared with 1908 there was a decrease of 14.89 per cent in the quantity and an increase in the value of 19.40 per cent. Among the products of special importance were the following: Lobsters, 5,545,884 pounds, valued at \$1,411,548; cod, fresh and salted, 14,078,389 pounds, valued at \$542,139; herring, fresh, salted, and smoked, 86,813,876 pounds, valued at \$462,506; haddock, fresh and salted, 11,197,811 pounds, valued at \$335,027; and hake, fresh and salted, 16,113,635 pounds, valued at \$329,483.

FISHERIES BY COUNTIES.

Statistics as to number of persons employed, investment, and products of the fisheries of Maine in 1919 are given by counties in the following table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES.

| Item. | Cumberland. | | Hancock. | | Kennebec. | | Knox. | |
|-----------------------------------|-------------|--------|----------|--------|-----------|--------|---------|--------|
| | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| PERSONS ENGAGED. | | | | | | | | |
| On vessels fishing..... | 321 | ..... | 180 | ..... |  | ..... | 254 | ..... |
| On vessels transport- ing..... | 19 | ..... | 64 | ..... |  | ..... | 47 | ..... |
| In shore fisheries..... | 621 | ..... | 1,489 | ..... | 36 | ..... | 676 | ..... |
| Shoresmen..... | 852 | ..... | 1,145 | ..... |  | ..... | 668 | ..... |
| Total..... | 1,813 | ..... | 2,778 | ..... | 36 | ..... | 1,615 | ..... |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

| Item. | Cumberland. | | Hancock. | | Kennebec. | | Knox. | |
|--|-------------|-----------|-----------|-----------|-----------|--------|-----------|-------------|
| | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| INVESTMENT. | | | | | | | | |
| Vessels fishing: | | | | | | | | |
| Steam..... | 1 | \$2,500 | | | | | 4 | \$1,000,000 |
| Tonnage..... | 9 | | | | | | 653 | |
| Outfit..... | | 300 | | | | | | 69,750 |
| Gasoline..... | 62 | 214,250 | 27 | \$85,500 | | | 40 | 66,200 |
| Tonnage..... | 80 | | 272 | | | | 308 | |
| Outfit..... | | 40,382 | | 9,855 | | | | 8,750 |
| Sail..... | | | 1 | 33,000 | | | | |
| Tonnage..... | | | 32 | | | | | |
| Outfit..... | | | | 25,800 | | | | |
| Vessels transporting: | | | | | | | | |
| Gasoline..... | 9 | 26,900 | 29 | 69,530 | | | 22 | 81,200 |
| Tonnage..... | 76 | | 263 | | | | 213 | |
| Outfit..... | | 3,075 | | 21,250 | | | | 13,128 |
| Sail..... | | | 1 | 15,000 | | | | |
| Tonnage..... | | | 75 | | | | | |
| Outfit..... | | | | 6,200 | | | | |
| Boats: | | | | | | | | |
| Power..... | 488 | 173,325 | 832 | 286,210 | | | 522 | 147,900 |
| Sail, row, etc. | 150 | 4,070 | 654 | 15,195 | 12 | \$320 | 537 | 17,995 |
| Apparatus, vessel fisheries: | | | | | | | | |
| Other trawl..... | 3 | 90 | | | | | | 2,050 |
| Line..... | | 18,112 | | 1,300 | | | | 3,345 |
| Seines..... | | 26,320 | 11 | 12,700 | | | | 19,300 |
| Gill nets..... | 80 | 22,500 | | | | | 30 | 750 |
| Harpoons..... | | 1,705 | | | | | | 25 |
| Lobster pots..... | | | 22 | 25 | | | 35 | 1,700 |
| Dredges..... | | | | | | | | 400 |
| Apparatus, shore fisheries: | | | | | | | | |
| Pound nets, trap nets, and seines..... | 17 | 11,800 | 2 | 170,200 | | | 75 | 50,400 |
| Lines, hand and trawl..... | | 13,984 | | 25,976 | | | | 8,355 |
| Gill nets..... | 1,020 | 29,630 | 213 | 6,265 | 19 | 550 | 6 | 120 |
| Seines..... | 42 | 14,130 | 10 | 10,150 | | | 20 | 3,200 |
| Bag nets and pocket nets..... | | | 15 | 1,025 | 6 | 450 | | |
| Fyke nets..... | 1 | 200 | | | 81 | 1,485 | | |
| Dip nets..... | | | 4 | 12 | | | 22 | 43 |
| Lobster pots..... | 20,696 | 41,731 | 38,101 | 96,291 | | | 28,270 | 55,505 |
| Eel pots and traps..... | | | 60 | 99 | 28 | 55 | 12 | 25 |
| Other trawls..... | 15 | 475 | 1 | 60 | | | 5 | 250 |
| Crab traps..... | 150 | 350 | | | | | | |
| Cunner traps..... | 80 | 110 | | | | | | |
| Spears..... | | | 13 | 15 | | | | |
| Harpoons..... | | 30 | | | | | | |
| Hoes and forks..... | 119 | 119 | 424 | 424 | | | 69 | 70 |
| Dredges..... | | | 15 | 1,650 | | | 9 | 860 |
| Shore and accessory property..... | | 1,508,540 | | 1,538,515 | | | | 1,363,515 |
| Cash capital..... | | 440,607 | | 116,550 | | | | 181,820 |
| Total..... | | 2,954,138 | | 2,522,718 | | 2,860 | | 3,108,726 |
| PRODUCTS. | | | | | | | | |
| Albacore..... | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Fresh..... | 4,925 | \$3 | 134,631 | \$3,628 | | | 224,200 | \$484 |
| Salted..... | | | 69 | 6 | | | | |
| Smoked..... | | | 39,973 | 3,077 | | | 109,620 | 6,187 |
| Bluefish..... | 39 | 7 | | | | | | |
| Bonito..... | 44 | 4 | | | | | | |
| Butterfish..... | 15,134 | 1,392 | | | | | 178 | 21 |
| Catfish and codfish..... | 36,922 | 772 | 86 | 2 | | | 46,300 | 1,266 |
| Cod..... | | | | | | | | |
| Fresh..... | 3,841,651 | 194,130 | 2,627,161 | 67,777 | | | 2,751,122 | 98,607 |
| Salted..... | | | 954,959 | 59,960 | | | 2,000 | 300 |
| Cunner..... | 30,695 | 615 | | | | | | |
| Cusk..... | 564,601 | 20,180 | 113,772 | 1,599 | | | 72,749 | 1,510 |
| Eels..... | | | 7,050 | 950 | 7,050 | \$600 | 1,000 | 100 |
| Flounders..... | 145,223 | 1,200 | 17,900 | 805 | | | 124,537 | 6,544 |
| Hardlock..... | | | | | | | | |
| Fresh..... | 1,460,468 | 40,701 | 579,031 | 23,267 | | | 7,683,357 | 220,907 |
| Salted..... | | | 73,400 | 2,812 | | | | |
| Hake..... | | | | | | | | |
| Fresh..... | 1,961,556 | 80,874 | 3,648,370 | 119,679 | | | 2,456,121 | 44,929 |
| Salted..... | | | 290 | 15 | | | 509 | 75 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

| Item. | Cumberland. | | Hancock. | | Kennebec. | | Knox. | |
|-----------------------|-------------|---------|------------|---------|-----------|---------|------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| PRODUCTS—continued. | | | | | | | | |
| Hallibut: | | | | | | | | |
| Fresh..... | 38,215 | \$6,507 | 21,087 | \$3,522 | | | 72,048 | \$9,918 |
| Salted..... | | | 1,000 | 80 | | | | |
| Herring: | | | | | | | | |
| Fresh..... | 3,390,072 | 33,763 | 22,178,901 | 122,641 | | | 9,888,575 | 45,009 |
| Smoked..... | | | | | | | 29,000 | 1,700 |
| Mackerel, fresh..... | 223,184 | 33,918 | 16,214 | 2,100 | | | 41,747 | 5,926 |
| Pollock: | | | | | | | | |
| Fresh..... | 1,984,382 | 45,739 | 817,583 | 12,212 | | | 1,321,818 | 24,136 |
| Salted..... | | | 7,700 | 245 | | | | |
| Rosefish..... | 15,617 | 219 | | | | | | |
| Salmon, Atlantic..... | 961 | 89 | 7,050 | 2,795 | | | | |
| Shad..... | 22,032 | 1,584 | 78,286 | 4,840 | 7,280 | \$1,365 | 120,843 | 2,429 |
| Sharks..... | 27,729 | 622 | | | | | 529 | 15 |
| Skates..... | 2,385 | 47 | | | | | | |
| Smelt..... | 136,202 | 12,345 | 95,435 | 16,470 | 1,350 | 340 | 93,600 | 17,150 |
| Sturgeon..... | 1,618 | 177 | 2,000 | 160 | | | 784 | 207 |
| Suckers..... | 3,000 | 240 | | | 55,300 | 6,540 | | |
| Swordfish..... | 307,711 | 74,513 | | | | | 27,000 | 5,840 |
| Tautog..... | 14 | 2 | | | | | | |
| Tomeel..... | | | | | 65,175 | 1,955 | | |
| Tuna..... | 8,754 | 600 | | | | | | |
| Whiting: | | | | | | | | |
| Fresh..... | 610,535 | 4,016 | | | | | 11,100 | 61 |
| Salted..... | 3,000 | 90 | | | | | | |
| Squid..... | 377 | 4 | | | | | | |
| Lobsters..... | 670,050 | 187,904 | 1,394,959 | 346,903 | | | 1,362,219 | 348,850 |
| Crabs, hard..... | 70,575 | 3,595 | | | | | | |
| Clams, soft..... | 442,659 | 48,131 | 636,135 | 42,416 | | | 162,070 | 10,376 |
| Scallops..... | | | 30,800 | 14,200 | | | 41,712 | 17,216 |
| Mussels..... | | | | | | | 16,970 | 367 |
| Sound..... | 692 | 13 | 120 | 1 | | | 4,200 | 42 |
| Spawn..... | 10,546 | 363 | | | | | 272 | 20 |
| Livers..... | 74,949 | 1,009 | 1,100 | 13 | | | 3,063 | 40 |
| Total..... | 16,135,178 | 768,836 | 39,483,158 | 882,175 | 136,155 | 10,800 | 26,669,546 | 870,229 |

| Item. | Lincoln. | | Penobscot. | | Sagadahoc. | | Waldo. | |
|---------------------------------------|----------|----------|------------|--------|------------|----------|---------|----------|
| | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| PERSONS ENGAGED. | | | | | | | | |
| On vessels fishing..... | 88 | | | | | | | |
| On vessels transporting..... | 4 | | | | | | 8 | |
| In shore fisheries..... | 588 | | 53 | | 263 | | 146 | |
| Shoresmen..... | 92 | | 61 | | 5 | | 154 | |
| Total..... | 772 | | 114 | | 268 | | 308 | |
| INVESTMENT. | | | | | | | | |
| Vessels fishing: Gasoline..... | 17 | \$82,700 | | | | | | |
| Tonnage..... | 164 | | | | | | | |
| Outfit..... | | 7,051 | | | | | | |
| Vessels transporting: | | | | | | | | |
| Gasoline..... | 2 | 4,200 | | | | | 8 | \$18,800 |
| Tonnage..... | 16 | | | | | | 69 | |
| Outfit..... | | 1,165 | | | | | | 2,225 |
| Boats: | | | | | | | | |
| Power..... | 298 | 73,010 | 4 | \$600 | 136 | \$28,140 | 56 | 14,075 |
| Sail, row, etc..... | 410 | 11,440 | 39 | 1,550 | 162 | 4,890 | 186 | 10,054 |
| Apparatus, vessel fisheries: | | | | | | | | |
| Otter trawls..... | 1 | 50 | | | | | | |
| Lines..... | | 1,590 | | | | | | |
| Seines..... | 18 | 25,500 | | | | | | |
| Gill nets..... | 15 | 400 | | | | | | |
| Apparatus, shore fisheries: | | | | | | | | |
| Pound nets, trap nets, and weirs..... | 25 | 15,050 | 1 | 100 | 32 | 22,500 | 103 | 77,315 |
| Lines, hand and trawl..... | | 4,145 | | 1,200 | | 2,901 | | 200 |
| Gill nets..... | 759 | 18,755 | 60 | 705 | 287 | 8,776 | | |
| Seines..... | 18 | 7,550 | | | 3 | 500 | | |
| Bag nets and pocket nets..... | 16 | 1,200 | 6 | 550 | 9 | 750 | 13 | 1,300 |
| Fyke nets..... | 41 | 1,160 | | | 23 | 840 | | |
| Dip nets..... | 4 | 6 | | | | | | |
| Lobster pots..... | 16,366 | 33,175 | | | 3,213 | 6,505 | 600 | 1,200 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

| Item. | Lincoln. | | Penobscot. | | Sagadahoc. | | Waldo. | |
|--|-----------|---------|------------|--------|------------|---------|-----------|---------|
| | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| INVESTMENT—continued. | | | | | | | | |
| Apparatus, shore fisheries— | | | | | | | | |
| Continued. | | | | | | | | |
| Eel pots and traps..... | 43 | \$75 | 30 | \$60 | 289 | \$546 | 55 | \$115 |
| Otter trawls..... | 11 | 500 | | | 7 | 350 | | |
| Spears..... | 25 | 30 | | | | | | |
| Harpoons..... | | 55 | | | | 30 | | |
| Hoes and forks..... | 78 | 90 | | | 9 | 17 | | |
| Shore and accessory prop- erty..... | | 141,640 | | 82,600 | | 12,710 | | 195,216 |
| Cash capital..... | | 34,530 | | 10,000 | | 1,500 | | 20,000 |
| Total..... | | 465,067 | | 97,365 | | 90,955 | | 340,560 |
| PRODUCTS. | | | | | | | | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alwives: | | | | | | | | |
| Fresh..... | 40,200 | \$295 | 19,000 | \$400 | 3,200 | \$85 | 7,000 | \$190 |
| Salted..... | 6,800 | 170 | | | | | | |
| Smoked..... | 104,700 | 3,392 | | | 74,000 | 5,700 | | |
| Butterfish..... | 800 | 80 | | | 16,650 | 1,538 | | |
| Catfish and wolfish..... | 100 | 7 | | | | | | |
| Cod: | | | | | | | | |
| Fresh..... | 809,711 | 26,486 | | | 330,728 | 16,079 | 14,300 | 600 |
| Salted..... | 3,000 | 180 | | | | | | |
| Cusk..... | 46,971 | 1,440 | | | 14,720 | 587 | | |
| Eels..... | 52,000 | 4,060 | 24,000 | 2,400 | 175,650 | 12,525 | 8,000 | 800 |
| Flounders..... | 52,403 | 3,748 | | | 39,950 | 3,196 | | |
| Haddock, fresh..... | 188,714 | 5,593 | | | 32,382 | 1,187 | 2,000 | 80 |
| Hake, fresh..... | 1,079,617 | 18,805 | | | 309,940 | 12,238 | 4,300 | 130 |
| Hatibut, fresh..... | 811 | 122 | | | 11,040 | 1,750 | | |
| Herring: | | | | | | | | |
| Fresh..... | 5,174,117 | 41,658 | | | 641,400 | 5,011 | 5,479,880 | 22,518 |
| Smoked..... | 120,000 | 4,200 | | | | | | |
| Mackerel: | | | | | | | | |
| Fresh..... | 170,511 | 24,049 | | | 72,143 | 8,801 | 8,707 | 1,351 |
| Salted..... | 8,000 | 650 | | | | | | |
| Pollock, fresh..... | 468,170 | 9,076 | | | 109,650 | 1,773 | 4,000 | 110 |
| Rockfish..... | 800 | 12 | | | | | | |
| Salmon, Atlantic..... | | | 2,650 | 1,131 | 4,812 | 1,745 | 3,857 | 1,845 |
| Shad..... | 149,884 | 11,174 | 13 | 8 | 39,050 | 6,330 | 3,121 | 220 |
| Sharks..... | 2,644 | 193 | | | | | | |
| Smelt..... | 53,500 | 13,242 | 1,900 | 475 | 74,230 | 18,811 | 23,450 | 5,862 |
| Striped bass..... | | | | | 535 | 101 | 57 | 12 |
| Sturgeon..... | 950 | 184 | | | 2,777 | 986 | | |
| Sturgeon roe..... | | | | | 143 | 297 | | |
| Suckers..... | 40,500 | 3,810 | | | 11,600 | 1,262 | | |
| Tomcod..... | 37,160 | 1,116 | 24,000 | 600 | | | 15,000 | 375 |
| Tuna..... | 17,300 | 1,088 | | | 5,875 | 352 | | |
| Whiting, fresh..... | 400 | 4 | | | 59,600 | 596 | | |
| Lobsters..... | 619,886 | 152,327 | | | 147,664 | 39,739 | 8,800 | 640 |
| Clams, soft..... | 192,600 | 15,252 | | | 7,860 | 899 | | |
| Spawns..... | 163 | 8 | | | | | | |
| Livers..... | 4,375 | 73 | | | | | | |
| Total..... | 9,443,287 | 342,495 | 71,563 | 5,014 | 2,185,599 | 141,588 | 5,582,472 | 34,736 |

| Item. | Washington. | | York. | | Total. | |
|------------------------------|-------------|----------|---------|----------|---------|-------------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| PERSONS ENGAGED. | | | | | | |
| On vessels fishing..... | 58 | | 103 | | 1,004 | |
| On vessels transporting..... | 197 | | | | 339 | |
| In shore fisheries..... | 1,263 | | 197 | | 5,332 | |
| Seamen..... | 4,725 | | 9 | | 7,714 | |
| Total..... | 6,243 | | 309 | | 14,386 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Steam..... | | | | | 5 | \$1,002,500 |
| Tonnage..... | | | | | 662 | |
| Outfit..... | | | | | | 70,050 |
| Gasoline..... | 13 | \$33,500 | 14 | \$81,500 | 173 | 514,650 |
| Tonnage..... | 176 | | 311 | | 2,000 | |
| Outfit..... | | 11,228 | | 13,767 | | 91,013 |
| Coal..... | | | | | 4 | 53,000 |
| Tonnage..... | | | | | 392 | |
| Outfit..... | | | | | | 25,800 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN
1919, BY COUNTIES—Continued.

| Item. | Washington. | | York. | | Total. | |
|---------------------------------------|-------------|-----------|-----------|----------|------------|------------|
| INVESTMENT—continued. | | | | | | |
| Vessels transporting: | Number. | Value. | Number. | Value. | Number. | Value. |
| Steam..... | 2 | \$3,000 | | | 2 | \$3,000 |
| Tonnage..... | 28 | | | | 28 | |
| Outfit..... | | 2,800 | | | | 2,800 |
| Gasoline..... | 95 | 306,410 | | | 165 | 510,040 |
| Tonnage..... | 1,164 | | | | 1,762 | |
| Outfit..... | | 63,155 | | | | 103,998 |
| Sail..... | 1 | 1,715 | | | 2 | 16,715 |
| Tonnage..... | 46 | | | | 121 | |
| Outfit..... | | 175 | | | | 6,375 |
| Boats: | | | | | | |
| Power..... | 613 | 139,945 | 141 | \$38,875 | 3,090 | 902,080 |
| Sail, row, etc..... | 567 | 16,550 | 42 | 1,575 | 2,759 | 83,639 |
| Apparatus, vessel fisheries: | | | | | | |
| Otter trawls..... | | | 4 | 330 | 13 | 2,520 |
| Lines..... | | 745 | | 6,450 | | 34,747 |
| Seines..... | 5 | 9,450 | | | 84 | 93,270 |
| Gill nets..... | | | 375 | 5,949 | 1,253 | 29,689 |
| Harpoons..... | | | | 500 | | 2,230 |
| Lobster pots..... | | | | | 1,085 | 2,195 |
| Dredges..... | | | | | 4 | 400 |
| Apparatus, shore fisheries: | | | | | | |
| Pound nets, trap nets, and weirs..... | 194 | 158,275 | | | 690 | 514,665 |
| Lines, hand and trawl..... | | 4,245 | | 2,004 | | 61,410 |
| Gill nets..... | 65 | 1,573 | 357 | 4,849 | 2,786 | 71,214 |
| Seines..... | 1 | 4,700 | 4 | 3,825 | 103 | 44,055 |
| Bag nets and pocket nets..... | 35 | 3,400 | | | 95 | 8,675 |
| Fyke nets..... | | | | | 146 | 3,685 |
| Dip nets..... | 58 | 295 | 14 | 428 | 162 | 776 |
| Lobster pots..... | 38,685 | 126,630 | 7,061 | 21,218 | 153,532 | 382,258 |
| Eel pots and traps..... | 63 | 194 | 19 | 38 | 599 | 1,198 |
| Otter trawls..... | | | | | 39 | 1,635 |
| Crab traps..... | | | | | 180 | 330 |
| Cunner traps..... | | | | | 86 | 140 |
| Spears..... | | | 4 | 12 | 42 | 57 |
| Harpoons..... | | | | 100 | | 215 |
| Hoes and forks..... | 336 | 431 | 8 | 16 | 1,103 | 1,167 |
| Dredges..... | | | | | 24 | 2,500 |
| Shore and accessory property..... | | 6,646,220 | | 15,585 | | 11,864,571 |
| Cash capital..... | | 222,700 | | 2,000 | | 1,029,707 |
| Total..... | | 7,763,335 | | 139,004 | | 17,544,969 |
| PRODUCTS. | | | | | | |
| Alewives: | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Fresh..... | 147,650 | \$2,321 | | | 580,811 | \$7,455 |
| Salted..... | | | | | 6,860 | 176 |
| Smoked..... | 24,000 | 1,286 | | | 352,293 | 19,606 |
| Bluefish..... | | | | | 39 | 7 |
| Bonito..... | | | | | 44 | 4 |
| Butterfish..... | | | | | 32,763 | 3,031 |
| Catfish and wolfish..... | | | 841 | \$14 | 83,958 | 2,061 |
| Cod: | | | | | | |
| Fresh..... | 1,204,742 | 36,935 | 1,515,730 | 68,913 | 13,095,145 | 479,827 |
| Salted..... | 16,925 | 1,445 | 6,360 | 427 | 983,244 | 62,512 |
| Cunner..... | | | | | 30,695 | 615 |
| Cusk..... | 15,049 | 353 | 218,285 | 7,902 | 1,046,147 | 33,580 |
| Eels..... | 18,300 | 2,125 | 12,000 | 1,680 | 305,050 | 25,249 |
| Flounders..... | 2,740 | 251 | 86,911 | 3,377 | 469,594 | 22,227 |
| Haddock: | | | | | | |
| Fresh..... | 142,685 | 5,522 | 1,036,774 | 34,958 | 11,124,411 | 332,215 |
| Salted..... | | | | | 73,400 | 2,812 |
| Hake: | | | | | | |
| Fresh..... | 140,278 | 2,862 | 477,910 | 19,710 | 16,108,575 | 329,227 |
| Salted..... | 4,306 | 166 | | | 5,060 | 256 |
| Hallibut: | | | | | | |
| Fresh..... | 53,345 | 6,422 | 20,930 | 3,600 | 217,476 | 31,841 |
| Salted..... | | | | | 1,066 | 80 |
| Herring: | | | | | | |
| Fresh..... | 33,893,181 | 185,004 | | | 86,646,126 | 455,604 |
| Salted..... | 6,200 | 157 | | | 6,260 | 187 |
| Smoked..... | 12,550 | 815 | | | 161,550 | 6,715 |
| Mackerel: | | | | | | |
| Fresh..... | | | 61,000 | 5,280 | 593,566 | 81,428 |
| Salted..... | | | | | 8,000 | 650 |
| Pollock: | | | | | | |
| Fresh..... | 638,680 | 12,657 | 252,880 | 7,784 | 5,597,163 | 113,487 |
| Salted..... | 25,100 | 2,095 | 2,000 | 100 | 34,800 | 2,440 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

| Item. | Washington. | | York. | | Total. | |
|-------------------------|-------------|---------|-----------|---------|-------------|-----------|
| PRODUCTS—continued. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Rosefish..... | | | 905 | \$14 | 17,322 | \$245 |
| Salmon: | | | | | | |
| Atlantic..... | 1,280 | \$321 | | | 20,610 | 7,926 |
| Humpback..... | 316 | 62 | | | 310 | 62 |
| Shad..... | 4,000 | 300 | 446 | 53 | 414,455 | 28,393 |
| Sharks..... | | | 1,845 | 54 | 39,747 | 884 |
| Skates..... | | | | | 2,355 | 47 |
| Smelt..... | 36,300 | 8,226 | 8,000 | 1,575 | 523,967 | 94,496 |
| Striped bass..... | | | | | 592 | 113 |
| Sturgeon..... | | | | | 8,129 | 1,714 |
| Sturgeon roe..... | | | | | 143 | 297 |
| Suckers..... | | | | | 110,460 | 11,852 |
| Swordfish..... | | | 90,102 | 24,379 | 424,813 | 104,734 |
| Tautog..... | | | | | 14 | 2 |
| Tomcod..... | 5,825 | 465 | | | 147,160 | 4,511 |
| Tuna..... | | | | | 31,909 | 2,040 |
| Whiting: | | | | | | |
| Fresh..... | 3,335 | 50 | | | 684,970 | 4,727 |
| Salted..... | | | | | 3,000 | 90 |
| Squid..... | | | | | 377 | 4 |
| Lobsters..... | 849,306 | 206,425 | 493,000 | 128,700 | 5,545,884 | 1,411,548 |
| Crabs, hard..... | | | | | 170,575 | 3,595 |
| Clams, soft..... | 651,910 | 43,365 | 12,500 | 2,770 | 22,105,734 | 163,209 |
| Scallops..... | | | | | 72,512 | 31,416 |
| Mussels..... | | | | | 116,976 | 367 |
| Tongues and cheeks..... | 200 | 40 | 5,000 | 150 | 5,200 | 190 |
| Sounds..... | 200 | 40 | | | 5,212 | 96 |
| Spawn..... | 20 | 1 | 7,847 | 386 | 18,857 | 778 |
| Livers..... | 17,025 | 341 | 12,075 | 186 | 112,587 | 1,712 |
| Oil, liver..... | 3,755 | 375 | 4,875 | 520 | 8,625 | 895 |
| Total..... | 43,919,195 | 520,561 | 4,328,216 | 312,592 | 147,956,369 | 3,889,035 |

¹ 211,725 in number.
² 210,573 bushels.

³ 12,085 bushels.
⁴ 1,697 bushels.

⁵ 1,150 gallon.

FISHERIES BY APPARATUS.

In the fisheries of Maine in 1919 pots ranked above all other forms of apparatus in the value of their catch, with 5,793,784 pounds of lobsters, valued at \$1,432,004, and 247,950 pounds of eels, valued at \$20,480. Lines ranked second with 32,992,588 pounds, valued at \$978,134, the principal species taken with lines arranged in the order of their value being: Cod, 7,432,231 pounds, valued at \$397,322; hake, 15,230,183 pounds, valued at \$309,878; and haddock, 3,857,610 pounds, valued at \$129,678. The yield of the pound net, trap net, and weir fishery amounted to 76,231,256 pounds, valued at \$452,146, of which 74,043,982 pounds, valued at \$362,339, were herring. Otter trawls taking mostly haddock, cod, and flounders, yielded 9,316,245 pounds, valued at \$296,356. Various species were taken in seines to the amount of 15,626,164 pounds, valued at \$220,530, and in gill nets to the amount of 4,283,308 pounds, valued at \$156,516. The catch with hoes and forks, consisting principally of soft clams, amounted to 2,122,704 pounds, valued at \$163,576; and that with harpoons, consisting mostly of swordfish, amounted to 452,633 pounds, valued at \$106,499. The combined catch of all forms of fishing apparatus employed in both the shore and vessel fisheries amounted to 147,956,369 pounds, valued at \$3,889,035.

The following tables show by counties, apparatus, and species the products of the vessel and shore fisheries of Maine in 1919:

YIELD OF VESSEL FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

| Apparatus and species. | Cumberland. | | Hancock. | | Knox. | | Lincoln. | |
|------------------------|-------------|---------|-----------|--------|-----------|---------|-----------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Otter trawls: | | | | | | | | |
| Butterfish | | | | | 25 | 85 | | |
| Catfish and wolf-fish | | | | | 45,660 | 1,241 | | |
| Cod | | | | | 1,389,051 | 59,729 | | |
| Flounders | 20,034 | \$631 | | | 67,301 | 3,088 | 8,695 | \$260 |
| Haddock | | | | | 7,001,906 | 196,051 | | |
| Hake | | | | | 52,232 | 2,114 | | |
| Halibut | | | | | 46,207 | 7,856 | | |
| Pollock | | | | | 64,940 | 1,560 | | |
| Sharks | | | | | 19 | 1 | | |
| Sturgeon | | | | | 784 | 207 | | |
| Spawn | | | | | 150 | 11 | | |
| Total | 20,034 | 631 | | | 8,668,305 | 271,897 | 8,695 | 260 |
| Liners: | | | | | | | | |
| Catfish and wolf-fish | 5,815 | 152 | 86 | \$2 | 649 | 25 | 100 | 7 |
| Cod | | | | | | | | |
| Fresh | 1,384,643 | 59,534 | 285,519 | 6,908 | 505,993 | 17,025 | 69,484 | 2,683 |
| Salted | | | 951,000 | 59,660 | | | | |
| Cusk | 483,865 | 17,310 | 1,816 | 29 | 21,129 | 562 | 13,936 | 497 |
| Flounders | 5,823 | 95 | 30 | 1 | 286 | 6 | 123 | 2 |
| Haddock— | | | | | | | | |
| Fresh | 696,608 | 19,616 | 14,920 | 734 | 320,181 | 9,813 | 18,080 | 482 |
| Salted | | | 73,400 | 2,812 | | | | |
| Hake | 839,392 | 34,380 | 108,385 | 1,999 | 853,597 | 15,378 | 138,749 | 3,001 |
| Halibut— | | | | | | | | |
| Fresh | 34,353 | 5,842 | 3,707 | 556 | 3,566 | 540 | 11 | 2 |
| Salted | | | 1,000 | 80 | | | | |
| Pollock— | | | | | | | | |
| Fresh | 146,531 | 4,952 | 43,443 | 626 | 206,982 | 3,641 | 3,931 | 106 |
| Salted | | | 7,700 | 245 | | | | |
| Rosefish | 14,332 | 199 | | | | | 800 | 12 |
| Sharks | 1,827 | 49 | | | 200 | 5 | 644 | 13 |
| Skates | 188 | 3 | | | | | | |
| Somids | | | 120 | 1 | | | | |
| Spawn | 7,240 | 263 | | | 122 | 9 | 163 | 8 |
| Livers | 24,893 | 454 | | | 2,413 | 32 | 4,375 | 73 |
| Total | 3,645,510 | 142,849 | 1,491,126 | 73,653 | 1,915,118 | 47,036 | 250,396 | 6,886 |
| Seines: | | | | | | | | |
| Alewives | 3,800 | 45 | | | | | 5,000 | 39 |
| Butterfish | 628 | 80 | | | 153 | 15 | | |
| Cod | | | 1,934 | 83 | | | 612 | 26 |
| Flounders | 20 | 1 | | | | | | |
| Haddock | | | | | | | 25 | 1 |
| Hake | | | 110 | 5 | | | | |
| Herring | 3,167,907 | 31,542 | 776,500 | 7,655 | 1,029,975 | 8,244 | 2,827,367 | 29,763 |
| Mackerel— | | | | | | | | |
| Fresh | 25,488 | 4,004 | 11,214 | 1,650 | 20,126 | 3,239 | 98,344 | 15,029 |
| Salted | | | | | | | 8,000 | 650 |
| Pollock | 139,094 | 3,342 | 283,580 | 4,928 | 725,592 | 12,513 | 85,561 | 1,545 |
| Salmon, Atlantic | 7 | 2 | | | | | | |
| Shad | 9,368 | 695 | 68,286 | 4,140 | 118,343 | 2,229 | 103,336 | 6,440 |
| Sharks | 5,275 | 142 | | | 310 | 9 | | |
| Smelt | 16,422 | 1,565 | | | | | | |
| Sturgeon | 202 | 15 | | | | | | |
| Whiting | 2,065 | 16 | | | 11,100 | 61 | 400 | 4 |
| Livers | 1,023 | 16 | 1,100 | 13 | 650 | 8 | | |
| Total | 3,371,299 | 41,465 | 1,142,724 | 18,474 | 1,906,249 | 26,318 | 3,128,645 | 49,497 |
| Gill nets: | | | | | | | | |
| Catfish and wolf-fish | 978 | 33 | | | | | | |
| Cod—Fresh | 543,253 | 22,660 | | | | | 11,500 | 345 |
| Cusk | 1,620 | 103 | | | | | | |
| Flounders | 2,690 | 60 | | | | | | |
| Haddock | 164,591 | 4,556 | | | | | 1,230 | 38 |
| Hake | 37,107 | 1,449 | | | | | 950 | 18 |
| Halibut | 18 | 2 | | | | | | |
| Mackerel | 46,115 | 6,011 | | | 12,500 | 1,500 | | |
| Pollock | 626,359 | 15,032 | | | | | 1,450 | 27 |
| Rosefish | 55 | 2 | | | | | | |

YIELD OF VESSEL FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Cumberland. | | Hancock. | | Knox. | | Lincoln. | |
|-----------------------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| Gill nets—Continued. | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Shad..... | 262 | \$23 | | | | | | |
| Sharks..... | 4,150 | 101 | | | | | | |
| Skates..... | 55 | 2 | | | | | | |
| Sturgeon..... | 400 | 47 | | | | | | |
| Lobsters..... | 50 | 24 | | | | | | |
| Spawn..... | 1,110 | 34 | | | | | | |
| Livers..... | 5,906 | 106 | | | | | | |
| Total..... | 1,434,719 | 50,245 | | | 12,500 | \$1,500 | 15,130 | \$428 |
| Harpoons: Swordfish..... | 305,200 | 73,963 | | | 27,300 | 5,840 | | |
| Lobster pots: Lobsters..... | | | 14,845 | \$3,750 | 48,125 | 12,033 | | |
| Dredges: Scallops..... | | | | | 12,968 | 5,340 | | |
| Grand total..... | 8,776,762 | 309,153 | 2,648,695 | 95,877 | 12,590,265 | 369,973 | 3,402,866 | 57,071 |

| Apparatus and species. | Washington. | | York. | | Total. | |
|---------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| Otter trawls: | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Butterfish..... | | | | | 25 | 86 |
| Catfish and wolffish..... | | | | | 45,660 | 1,241 |
| Cod..... | | | | | 1,389,051 | 59,729 |
| Flounders..... | | | 31,000 | \$1,050 | 127,030 | 5,029 |
| Haddock..... | | | | | 7,001,906 | 196,054 |
| Hake..... | | | | | 52,262 | 2,144 |
| Halibut..... | | | | | 46,207 | 7,836 |
| Pollock..... | | | 270 | 9 | 65,210 | 1,569 |
| Sharks..... | | | | | 19 | 1 |
| Sturgeon..... | | | | | 784 | 207 |
| Spawn..... | | | | | 150 | 11 |
| Total..... | | | 31,270 | 1,059 | 8,728,304 | 273,847 |
| Lines: | | | | | | |
| Catfish and wolffish..... | | | 662 | 11 | 7,312 | 197 |
| Cod— | | | | | | |
| Fresh..... | 270,390 | \$8,278 | 1,015,546 | 44,994 | 3,561,575 | 139,422 |
| Salted..... | 500 | 60 | | | 951,500 | 59,720 |
| Cusk..... | 11,040 | 275 | 208,076 | 7,519 | 739,862 | 26,182 |
| Flounders..... | 240 | 1 | | | 6,502 | 105 |
| Haddock— | | | | | | |
| Fresh..... | 18,075 | 688 | 829,952 | 23,236 | 1,897,816 | 54,569 |
| Salted..... | | | | | 73,400 | 2,812 |
| Hake..... | 17,643 | 651 | 385,296 | 15,797 | 2,343,032 | 71,296 |
| Halibut— | | | | | | |
| Fresh..... | 15,180 | 1,985 | 17,889 | 3,039 | 74,697 | 11,964 |
| Salted..... | | | | | 1,000 | 89 |
| Pollock— | | | | | | |
| Fresh..... | 42,630 | 701 | 32,550 | 784 | 4,476,067 | 10,810 |
| Salted..... | | | | | 7,760 | 245 |
| Roadfish..... | | | 905 | 14 | 16,037 | 225 |
| Sharks..... | | | 155 | 3 | 2,826 | 70 |
| Skates..... | | | | | 188 | 3 |
| Sounds..... | | | | | 120 | 1 |
| Spawn..... | 29 | 1 | 7,529 | 369 | 15,083 | 650 |
| Livers..... | 25 | 1 | 11,125 | 174 | 42,831 | 734 |
| Total..... | 375,752 | 12,641 | 2,539,646 | 95,940 | 10,217,548 | 379,005 |
| Seines: | | | | | | |
| Alewives..... | | | | | 8,860 | 81 |
| Butterfish..... | | | | | 781 | 95 |
| Cod..... | | | | | 2,546 | 109 |
| Flounders..... | | | | | 20 | 1 |
| Haddock..... | | | | | 25 | 1 |
| Hake..... | | | | | 110 | 5 |
| Herring..... | 2,348,400 | 9,785 | | | 10,150,149 | 82,980 |
| Mackerel— | | | | | | |
| Fresh..... | | | | | 155,172 | 23,922 |
| Salted..... | | | | | 8,000 | 650 |
| Pollock..... | 215,000 | 2,960 | | | 1,448,827 | 25,288 |
| Salmon, Atlantic..... | | | | | 7 | 2 |
| Shad..... | | | | | 299,333 | 13,504 |
| Shark..... | | | | | 5,355 | 151 |
| Smelt..... | | | | | 10,422 | 1,565 |
| Sturgeon..... | | | | | 202 | 15 |
| Whiting..... | | | | | 13,565 | 81 |
| Liver..... | | | | | 2,773 | 37 |
| Total..... | 2,563,400 | 12,745 | | | 12,112,317 | 148,499 |

YIELD OF VESSEL FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Washington. | | York. | | Total. | |
|------------------------|-------------|----------|-----------|---------|------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Gill nets: | | | | | | |
| Catfish and wolffish | | | 79 | \$2 | 1,057 | \$35 |
| Cod— | | | | | | |
| Fresh | | | 165,130 | 7,100 | 719,883 | 39,105 |
| Salted | | | 4,360 | 327 | 4,360 | 327 |
| Cusk | | | 1,145 | 42 | 2,765 | 145 |
| Flounders | | | 271 | 7 | 2,961 | 67 |
| Haddock | | | 47,226 | 1,137 | 213,047 | 5,731 |
| Hake | | | 25,169 | 1,032 | 63,226 | 2,489 |
| Halibut | | | | | 18 | 2 |
| Mackerel | | | | | 58,615 | 7,511 |
| Pollock | | | 104,960 | 2,628 | 732,769 | 17,687 |
| Rosefish | | | | | 55 | 2 |
| Shad | | | 446 | 53 | 708 | 76 |
| Sharks | | | 690 | 21 | 4,840 | 122 |
| Skates | | | | | 55 | 2 |
| Sturgeon | | | | | 400 | 47 |
| Lobsters | | | | | 50 | 24 |
| Spawn | | | 318 | 17 | 1,428 | 51 |
| Livers | | | 950 | 12 | 6,856 | 118 |
| Total | | | 350,744 | 12,378 | 1,813,093 | 64,551 |
| Harpoons: Swordfish | | | 89,302 | 24,179 | 421,502 | 103,982 |
| Lobster pots: Lobsters | | | | | 62,970 | 13,783 |
| Dredges: Scallops | | | | | 12,968 | 5,349 |
| Grand total | 2,939,152 | \$25,386 | 3,010,962 | 133,550 | 33,368,702 | 991,016 |

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

| Apparatus and species. | Cumberland. | | Hancock. | | Kennebec. | | Knox. | |
|-----------------------------------|-------------|--------|------------|---------|-----------|--------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Pound nets, trap nets, and weirs: | | | | | | | | |
| Alewives— | | | | | | | | |
| Fresh | 1,125 | \$6 | 99,636 | \$3,128 | | | | |
| Salted | | | 69 | 6 | | | | |
| Smoked | | | 31,373 | 2,577 | | | 55,670 | \$3,340 |
| Bluefish | 39 | 7 | | | | | | |
| Bonito | 11 | 1 | | | | | | |
| Butterfish | 11,507 | 1,312 | | | | | | |
| Herring— | | | | | | | | |
| Fresh | 197,420 | 1,974 | 20,902,401 | 110,086 | | | 8,858,600 | 36,765 |
| Smoked | | | | | | | 29,000 | 1,700 |
| Mackerel | 113,686 | 17,927 | | | | | 9,121 | 1,187 |
| Pollock | 426,957 | 8,945 | 6,700 | 100 | | | | |
| Salmon, Atlantic | 951 | 87 | 7,050 | 2,795 | | | | |
| Shad | 9,302 | 650 | | | | | | |
| Sharks | 16,477 | 330 | | | | | | |
| Smelt | | | 1,600 | 405 | | | | |
| Sturgeon | 1,016 | 115 | | | | | | |
| Tautog | 11 | 2 | | | | | | |
| Tuna | 4,089 | 275 | | | | | | |
| Whiting— | | | | | | | | |
| Fresh | 608,470 | 4,000 | | | | | | |
| Salted | 3,090 | 90 | | | | | | |
| Squid | 377 | 1 | | | | | | |
| Total | 1,397,477 | 35,728 | 21,051,820 | 119,097 | | | 8,952,391 | 42,992 |
| Lines: | | | | | | | | |
| Catfish and wolffish | 23,829 | 587 | | | | | | |
| Cod— | | | | | | | | |
| Fresh | 1,276,020 | 54,905 | 1,979,108 | 52,205 | | | 856,078 | 21,853 |
| Salted | | | 3,959 | 300 | | | 2,000 | 300 |
| Cusk | 79,116 | 2,776 | 111,956 | 1,570 | | | 51,620 | 948 |
| Flounders | | | 7,800 | 404 | | | 5,000 | 100 |
| Haddock | 577,269 | 15,939 | 564,111 | 22,533 | | | 361,270 | 15,040 |
| Hake | | | | | | | | |
| Fresh | 1,115,037 | 45,045 | 9,525,075 | 147,450 | | | 1,505,565 | 26,557 |
| Salted | | | 260 | 15 | | | 500 | 75 |
| Halibut | 3,844 | 663 | 17,380 | 2,963 | | | 22,275 | 1,522 |

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Cumberland. | | Hancock. | | Kennebec. | | Knox. | |
|---|-------------|---------|------------|---------|-----------|--------|------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Lines—Continued. | | | | | | | | |
| Pollock, fresh. | 127,244 | \$2,637 | 404,860 | \$5,403 | | | 324,304 | \$6,422 |
| Rosefish. | 1,230 | 18 | | | | | | |
| Skates. | 2,142 | 42 | | | | | | |
| Smelt. | | | 72,650 | 13,250 | | | 25,000 | 5,500 |
| Sounds. | 692 | 13 | | | | | 4,200 | 42 |
| Spawn. | 2,196 | 66 | | | | | | |
| Livers. | 43,127 | 433 | | | | | | |
| Total. | 3,257,746 | 123,124 | 12,688,159 | 245,067 | | | 3,157,812 | 78,359 |
| Gill nets: | | | | | | | | |
| Alsewives, smoked. | | | | | | | 15,000 | 900 |
| Cod, fresh. | 637,735 | 27,331 | 390,600 | 8,580 | | | | |
| Flounders. | 2,000 | 90 | | | | | | |
| Haddock. | 21,000 | 590 | | | | | | |
| Hake. | | | 15,000 | 225 | | | | |
| Macarel. | 37,805 | 5,575 | | | | | | |
| Pollock. | | | 10,000 | 125 | | | | |
| Shad. | | | | | 7,280 | 1,365 | | |
| Smelt. | | | 2,000 | 160 | | | | |
| Total. | 698,630 | 33,987 | 417,600 | 9,060 | 7,280 | 1,365 | 15,000 | 900 |
| Seines: | | | | | | | | |
| Herring. | 24,715 | 217 | 500,000 | 1,200 | | | | |
| Macarel. | | | 5,000 | 170 | | | | |
| Pollock. | 518,197 | 10,531 | 60,000 | 1,000 | | | | |
| Shad. | 3,100 | 216 | 10,000 | 700 | | | 2,500 | 200 |
| Smelt. | 119,780 | 10,780 | 11,000 | 1,200 | | | 63,000 | 10,150 |
| Total. | 665,822 | 22,074 | 586,000 | 8,280 | | | 65,500 | 10,350 |
| Bag nets and pocket nets: | | | | | | | | |
| Smelt. | | | 8,785 | 1,615 | 1,350 | 340 | | |
| Tomcod. | | | | | 26,900 | 795 | | |
| Total. | | | 8,785 | 1,615 | 27,850 | 1,135 | | |
| Fyke nets: | | | | | | | | |
| Eels. | | | | | 500 | 60 | | |
| Smelt. | 3,600 | 240 | | | 55,300 | 6,540 | | |
| Tomcod. | | | | | 38,675 | 1,160 | | |
| Total. | 3,600 | 240 | | | 94,475 | 7,760 | | |
| Dip nets: | | | | | | | | |
| Alsewives— | | | | | | | | |
| Fresh. | | | 35,000 | 500 | | | 224,200 | 484 |
| Smoked. | | | 5,600 | 500 | | | 38,950 | 1,947 |
| Smelt. | | | | | | | 5,000 | 1,500 |
| Total. | | | 40,600 | 1,000 | | | 268,150 | 3,931 |
| Eel pots, eel traps, and lobster pots: | | | | | | | | |
| Eels. | | | 3,050 | 350 | 6,550 | 549 | 1,000 | 100 |
| Lobster. | 670,000 | 187,880 | 1,380,114 | 343,153 | | | 1,314,094 | 336,817 |
| Total. | 670,000 | 187,880 | 1,383,164 | 343,503 | 6,550 | 549 | 1,315,094 | 336,917 |
| Otter trawl: | | | | | | | | |
| Flounder. | 114,656 | 3,432 | 10,000 | 400 | | | 51,950 | 3,347 |
| Hake. | | | | | | | 15,000 | 850 |
| Total. | 114,656 | 3,432 | 10,000 | 400 | | | 66,950 | 4,197 |
| Crab traps and cunner traps: | | | | | | | | |
| Crabs, hard. | 70,975 | 3,505 | | | | | | |
| Cunner. | 3,005 | 615 | | | | | | |
| Total. | 74,980 | 4,120 | | | | | | |
| Spence's fish: | | | 1,000 | 600 | | | | |
| Harpoons: | | | | | | | | |
| Swordfish. | 2,311 | 55 | | | | | | |
| Tuna. | 1,015 | 75 | | | | | | |
| Total. | 3,326 | 130 | | | | | | |
| Hook and fork: | | | | | | | | |
| Clams, soft. | 442,650 | 48,171 | 626,135 | 42,116 | | | 162,070 | 10,376 |
| Macarel. | | | | | | | 16,970 | 367 |
| Total. | 442,650 | 48,171 | 626,135 | 42,116 | | | 179,040 | 10,743 |
| Dredge and bottom: | | | | | | | | |
| Crab, soft. | | | 30,800 | 11,200 | | | 28,744 | 11,867 |
| Ground rock. | 7,558,116 | 159,683 | 30,826,463 | 786,298 | 136,155 | 10,809 | 14,079,281 | 500,256 |

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Lincoln. | | Penobscot. | | Sagadahoc. | | Waldo. | |
|-----------------------------------|-----------|--------|------------|--------|------------|--------|-----------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Found nets, trappnets, and weirs: | | | | | | | | |
| Alewives— | | | | | | | | |
| Fresh..... | 9,600 | \$103 | 9,000 | \$150 | 2,500 | \$50 | 7,000 | \$190 |
| Smoked..... | 24,700 | 992 | | | 74,000 | 5,700 | | |
| Butterfish..... | 800 | 80 | | | 16,650 | 1,538 | | |
| Cod..... | | | | | 900 | 54 | 2,300 | 120 |
| Eels..... | | | | | 30,350 | 2,204 | | |
| Herring— | | | | | | | | |
| Fresh..... | 1,446,750 | 9,645 | | | 581,400 | 4,411 | 5,479,880 | 22,518 |
| Smoked..... | 120,000 | 4,200 | | | | | | |
| Mackerel..... | 11,242 | 1,431 | | | 72,143 | 8,801 | 8,707 | 1,354 |
| Pollock..... | | | | | 97,400 | 1,463 | 4,000 | 110 |
| Salmon, Atlantic..... | | | 70 | 30 | 4,812 | 1,745 | 3,857 | 1,845 |
| Shad..... | 5,168 | 900 | | | 21,910 | 3,297 | 3,121 | 220 |
| Smelt..... | 856 | 170 | | | 4,935 | 1,234 | | |
| Striped bass..... | | | | | 535 | 101 | 57 | 12 |
| Sturgeon..... | | | | | 585 | 189 | | |
| Sturgeon roe..... | | | | | 30 | 90 | | |
| Suckers..... | 4,600 | 160 | | | | | | |
| Tomcod..... | 500 | 15 | | | | | | |
| Whiting, fresh..... | | | | | 59,600 | 596 | | |
| Total..... | 1,623,610 | 17,705 | 9,070 | 180 | 967,750 | 31,473 | 5,503,922 | 26,369 |
| Lines: | | | | | | | | |
| Cod, fresh..... | 353,336 | 12,361 | | | 225,378 | 10,973 | 12,000 | 480 |
| Cusk..... | 26,664 | 827 | | | 14,720 | 587 | | |
| Haddock..... | 84,692 | 2,813 | | | 31,042 | 1,147 | 2,000 | 80 |
| Hake, fresh..... | 400,614 | 7,777 | | | 141,390 | 6,365 | 4,300 | 130 |
| Halibut..... | 800 | 120 | | | 11,040 | 1,750 | | |
| Pollock, fresh..... | 171,646 | 3,767 | | | 12,250 | 310 | | |
| Salmon, Atlantic..... | | | 630 | 269 | | | | |
| Smelt..... | 16,670 | 4,150 | | | 51,125 | 12,784 | | |
| Total..... | 1,054,352 | 31,815 | 630 | 269 | 486,945 | 33,916 | 18,300 | 690 |
| Gill nets: | | | | | | | | |
| Alewives, fresh..... | | | 10,000 | 250 | 700 | 35 | | |
| Cod— | | | | | | | | |
| Fresh..... | 374,779 | 11,071 | | | 104,450 | 5,052 | | |
| Salted..... | 3,006 | 180 | | | | | | |
| Cusk..... | 6,371 | 116 | | | | | | |
| Haddock..... | 84,687 | 2,259 | | | 1,310 | 50 | | |
| Hake..... | 419,304 | 5,909 | | | 5,756 | 175 | | |
| Mackerel..... | 3,500 | 426 | | | | | | |
| Pollock..... | 159,582 | 2,556 | | | | | | |
| Salmon, Atlantic..... | | | 1,950 | \$82 | | | | |
| Shad..... | 28,880 | 3,625 | 13 | 8 | 17,140 | 3,033 | | |
| Sharks..... | 9,000 | 180 | | | | | | |
| Smelt..... | | | 300 | 75 | 150 | 38 | | |
| Sturgeon..... | 900 | 180 | | | 2,192 | 797 | | |
| Sturgeon roe..... | | | | | 113 | 207 | | |
| Total..... | 1,081,003 | 26,502 | 12,263 | 1,165 | 131,835 | 9,377 | | |
| Seines: | | | | | | | | |
| Herring..... | 900,000 | 6,250 | | | 60,000 | 600 | | |
| Mackerel..... | 57,425 | 7,163 | | | | | | |
| Pollock..... | 55,000 | 1,075 | | | | | | |
| Shad..... | 2,000 | 260 | | | | | | |
| Smelt..... | 19,950 | 4,850 | | | 5,400 | 1,350 | | |
| Sturgeon..... | 56 | 1 | | | | | | |
| Total..... | 1,034,425 | 19,542 | | | 65,400 | 1,950 | | |
| Bagnets and pocket nets: | | | | | | | | |
| Smelt..... | 16,100 | 4,072 | 1,600 | 400 | 8,500 | 2,375 | 23,450 | 5,862 |
| Tomcod..... | 30,000 | 900 | 24,000 | 600 | | | 15,000 | 375 |
| Total..... | 46,100 | 4,972 | 25,600 | 1,000 | 8,500 | 2,375 | 38,450 | 6,237 |
| Fyke nets: | | | | | | | | |
| Eels..... | | | | | 750 | 75 | | |
| Smelt..... | | | | | 4,120 | 1,030 | | |
| Suckers..... | 36,500 | 3,650 | | | 11,600 | 1,262 | | |
| Tomcod..... | 6,660 | 201 | | | | | | |
| Total..... | 43,160 | 3,851 | | | 16,470 | 2,367 | | |

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Lincoln. | | Penobscot. | | Sagadahoc. | | Waldo. | |
|--|------------------|----------------|----------------|---------------|------------------|----------------|----------------|---------------|
| Dip nets: | | | | | | | | |
| Alewives— | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Fresh..... | 25,600 | \$154 | | | | | | |
| Salted..... | 6,800 | 170 | | | | | | |
| Smoked..... | 80,000 | 2,400 | | | | | | |
| Total..... | 112,400 | 2,724 | | | | | | |
| Eel pots, eel traps, and lobster pots: | | | | | | | | |
| Eels..... | 34,500 | 2,660 | 24,000 | \$2,400 | 144,550 | \$10,246 | 8,000 | \$800 |
| Lobsters..... | 619,886 | 152,327 | | | 147,664 | 39,739 | 8,800 | 640 |
| Total..... | 654,386 | 154,987 | 24,000 | 2,400 | 292,214 | 49,985 | 16,800 | 1,440 |
| Otter trawls: | | | | | | | | |
| Flounders..... | 43,585 | 3,486 | | | 39,950 | 3,196 | | |
| Hake..... | 120,000 | 2,100 | | | 162,800 | 5,698 | | |
| Total..... | 163,585 | 5,586 | | | 202,750 | 8,894 | | |
| Spears: Eels..... | 17,500 | 1,400 | | | | | | |
| Harpoons: Tuna..... | 17,300 | 1,088 | | | 5,875 | 352 | | |
| Hoes and forks: Clams, soft..... | 192,600 | 15,252 | | | 7,860 | 899 | | |
| Total..... | 1,349,424 | 285,224 | 71,065 | 7,094 | 2,186,509 | 141,588 | 25,800 | 2,840 |

| Apparatus and species. | Washington. | | York. | | Total. | |
|-----------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| Pound nets, trap nets, and weirs: | | | | | | |
| Alewives— | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Fresh..... | 85,750 | \$1,421 | | | 214,611 | \$5,048 |
| Salted..... | | | | | 60 | 6 |
| Smoked..... | 4,600 | 300 | | | 192,743 | 12,909 |
| Bluefish..... | | | | | 39 | 7 |
| Butterfish..... | | | | | 4 | 4 |
| Cod..... | 2,000 | 57 | | | 31,957 | 2,930 |
| Eels..... | 2,000 | 150 | | | 5,200 | 231 |
| Flounders..... | 2,500 | 250 | | | 32,350 | 2,354 |
| Herring— | | | | | 2,500 | 250 |
| Fresh..... | 36,415,781 | 170,213 | | | 73,882,232 | 355,612 |
| Salted..... | 200 | 12 | | | 200 | 12 |
| Smoked..... | 12,550 | 815 | | | 161,750 | 6,715 |
| Mackerel..... | | | | | 214,899 | 30,700 |
| Pollock..... | 184,900 | 3,610 | | | 719,937 | 11,228 |
| Salmon— | | | | | | |
| Atlantic..... | 645 | 126 | | | 17,388 | 6,628 |
| Humpback..... | 310 | 62 | | | 310 | 62 |
| Shad..... | | | | | 39,501 | 5,076 |
| Sharks..... | | | | | 16,477 | 330 |
| Smelt..... | 6,245 | 1,336 | | | 13,630 | 3,345 |
| Striped bass..... | | | | | 592 | 113 |
| Sturgeon..... | | | | | 1,601 | 304 |
| Sturgeon roe..... | | | | | 30 | 90 |
| Suckers..... | | | | | 4,000 | 160 |
| Tautog..... | | | | | 14 | 2 |
| Tomcod..... | | | | | 500 | 15 |
| Tuna..... | | | | | 4,080 | 275 |
| Whiting— | | | | | | |
| Fresh..... | 3,335 | 50 | | | 671,405 | 4,646 |
| Salted..... | | | | | 3,000 | 90 |
| Squid..... | | | | | 377 | 4 |
| Total..... | 36,720,216 | 178,602 | | | 76,231,256 | 452,146 |
| Line..... | | | | | | |
| Coffin and soft-shell..... | | | | | 29,829 | 587 |
| Cod..... | | | | | | |
| Fresh..... | 27,500 | 28,600 | 260,500 | \$14,717 | 5,894,772 | 196,095 |
| Salted..... | 10,125 | 1,385 | 2,000 | 100 | 24,354 | 2,085 |
| Crab..... | 1,900 | 78 | 9,000 | 340 | 297,085 | 7,126 |
| Eels..... | | | 2,000 | 280 | 2,000 | 280 |
| Flounders..... | | | 45,400 | 1,816 | 58,200 | 2,320 |
| Haddock..... | 124,610 | 4,831 | 141,400 | 9,911 | 1,886,394 | 72,297 |

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Washington. | | York. | | Total. | |
|----------------------------------|-------------|---------|---------|---------|------------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Lines—Continued. | | | | | | |
| Hake— | | | | | | |
| Fresh..... | 122,635 | \$2,211 | 67,475 | \$2,881 | 12,882,091 | \$238,416 |
| Salted..... | 4,300 | 166 | | | 5,060 | 256 |
| Halibut..... | 38,165 | 4,437 | 3,050 | 561 | 96,554 | 12,019 |
| Pollock— | | | | | | |
| Fresh..... | 196,150 | 5,386 | 82,500 | 3,416 | 1,318,954 | 27,341 |
| Salted..... | 25,100 | 2,095 | 2,000 | 100 | 27,100 | 2,195 |
| Rosefish..... | | | | | 1,230 | 18 |
| Salmon, Atlantic..... | | | | | 630 | 259 |
| Sharks..... | | | 1,000 | 30 | 1,000 | 30 |
| Skates..... | | | | | 2,142 | 42 |
| Smelt..... | | | | | 166,375 | 35,684 |
| Tongues and cheeks..... | 200 | 40 | 5,000 | 150 | 5,200 | 190 |
| Sounds..... | 200 | 40 | | | 5,092 | 95 |
| Spawn..... | | | | | 2,196 | 66 |
| Livers..... | 17,000 | 390 | | | 60,127 | \$23 |
| Oil..... | 3,750 | 375 | 4,875 | 520 | 8,625 | 895 |
| Total..... | 1,484,896 | 50,037 | 626,200 | 34,822 | 22,775,040 | 599,129 |
| Gill nets: | | | | | | |
| Alewives— | | | | | | |
| Fresh..... | | | | | 10,700 | 285 |
| Smoked..... | | | | | 15,000 | 900 |
| Catfish and wolfish..... | | | 100 | 1 | 100 | 1 |
| Cod— | | | | | | |
| Fresh..... | | | 44,554 | 2,102 | 1,522,118 | 54,136 |
| Salted..... | | | | | 3,000 | 180 |
| Cusk..... | | | 64 | 1 | 6,435 | 117 |
| Flounders..... | | | 240 | 4 | 2,240 | 94 |
| Haddock..... | | | 18,196 | 674 | 125,223 | 3,563 |
| Hake..... | | | | | 440,054 | 6,309 |
| Herring— | | | | | | |
| Fresh..... | 3,000 | 40 | | | 3,000 | 40 |
| Salted..... | 6,000 | 175 | | | 6,000 | 175 |
| Mackerel..... | | | 9,000 | 1,080 | 50,395 | 7,482 |
| Pollock..... | | | 32,600 | 947 | 193,182 | 3,628 |
| Salmon, Atlantic..... | 500 | 150 | | | 2,450 | 982 |
| Shad..... | 4,000 | 390 | | | 57,313 | 8,421 |
| Sharks..... | | | | | 9,000 | 180 |
| Smelt..... | 18,350 | 4,045 | | | 18,800 | 4,158 |
| Sturgeon..... | | | | | 5,092 | 1,137 |
| Sturgeon roe..... | | | | | 113 | 207 |
| Total..... | 31,850 | 4,800 | 104,754 | 4,809 | 2,470,215 | 91,905 |
| Seines: | | | | | | |
| Flounders..... | | | 10,000 | 500 | 10,000 | 500 |
| Herring..... | 1,020,000 | 4,250 | | | 2,504,745 | 16,247 |
| Mackerel..... | | | 52,000 | 4,200 | 114,425 | 11,813 |
| Pollock..... | | | | | 642,197 | 12,936 |
| Shad..... | | | | | 17,600 | 1,316 |
| Smelt..... | 700 | 110 | 4,000 | 775 | 224,830 | 29,215 |
| Sturgeon..... | | | | | 50 | 4 |
| Total..... | 1,020,700 | 4,360 | 66,000 | 5,475 | 3,513,847 | 72,081 |
| Bag nets and pocket nets: | | | | | | |
| Smelt..... | 11,005 | 2,535 | | | 70,790 | 17,199 |
| Tomcod..... | 5,825 | 465 | | | 101,325 | 3,135 |
| Total..... | 16,830 | 3,000 | | | 172,115 | 20,334 |
| Fyke nets: | | | | | | |
| Eels..... | | | | | 1,250 | 135 |
| Smelt..... | | | | | 4,120 | 1,030 |
| Suckers..... | | | | | 106,400 | 11,692 |
| Tomcod..... | | | | | 45,335 | 1,361 |
| Total..... | | | | | 157,105 | 14,218 |
| Dip nets: | | | | | | |
| Alewives— | | | | | | |
| Fresh..... | 61,600 | 900 | | | 346,700 | 2,038 |
| Salted..... | | | | | 6,800 | 170 |
| Smoked..... | 20,000 | 950 | | | 144,550 | 5,797 |
| Herring..... | 106,000 | 716 | | | 106,000 | 716 |
| Salmon, Atlantic..... | 135 | 45 | | | 135 | 45 |
| Smelt..... | | | 4,000 | 800 | 9,000 | 2,300 |
| Total..... | 188,035 | 2,611 | 4,000 | 800 | 613,185 | 11,066 |

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Washington. | | York. | | Total. | |
|--|----------------|---------------|----------------|---------------|----------------|---------------|
| Eel pots, eel traps, and lobster pots: | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Eels..... | 16,300 | \$1,975 | 10,000 | \$1,400 | 247,950 | \$20,480 |
| Lobsters..... | 849,303 | 206,425 | 493,000 | 128,760 | 5,482,864 | 1,395,741 |
| Total..... | 865,606 | 208,400 | 503,000 | 130,160 | 5,730,814 | 1,416,221 |
| Otter trawls: | | | | | | |
| Flounders..... | | | | | 260,141 | 13,861 |
| Hake..... | | | | | 327,800 | 8,648 |
| Total..... | | | | | 587,941 | 22,509 |
| Crab traps and cunner traps: | | | | | | |
| Crabs, hard..... | | | | | 70,575 | 3,595 |
| Cunner..... | | | | | 30,695 | 615 |
| Total..... | | | | | 101,270 | 4,210 |
| Spears: Eels..... | | | | | 21,500 | 2,000 |
| Harpoons: | | | | | | |
| Swordfish..... | | | 800 | 200 | 3,311 | 752 |
| Tuna..... | | | | | 27,820 | 1,765 |
| Total..... | | | 800 | 200 | 31,131 | 2,517 |
| Hoes and forks: | | | | | | |
| Clams, soft..... | 651,910 | 43,365 | 12,500 | 2,770 | 2,105,734 | 163,209 |
| Mussels..... | | | | | 16,970 | 367 |
| Total..... | 651,910 | 43,365 | 12,500 | 2,770 | 2,122,704 | 163,576 |
| Dredges: Scallops..... | | | | | 39,544 | 26,067 |
| Grand total..... | 40,980,013 | 495,175 | 1,317,254 | 179,030 | 114,587,667 | 2,898,019 |

SALMON FISHERY OF PENOBSCOT RIVER AND BAY.

The greater part of the catch of Atlantic salmon in Maine is usually taken in Penobscot River and Bay. In 1920, the latest year for which statistics are available, there were 128 persons engaged in the salmon fishery in these waters. The investment included 68 weirs and traps, valued at \$6,175; 15 gill nets, valued at \$240; rods and lines to the value of \$1,500; 7 gasoline boats, valued at \$700; 85 rowboats, etc., valued at \$2,845; and shore and accessory property, valued at \$1,365; a total of \$12,825. The catch amounted to 1,598 salmon in number, or 15,135 pounds, having a value to the fishermen of \$7,210. The catch in 1919 was 1,322 salmon in number, or 13,557 pounds, valued at \$5,771. The following tables give the extent of this fishery by localities, in 1918, 1919, and 1920, and comparative statistics of the catch for various years from 1895 to 1920:

EXTENT, BY LOCALITIES, OF THE SALMON FISHERY OF PENOBSCOT RIVER AND BAY IN 1918, 1919, AND 1920.

| Town. | Weirs and traps. | | | | | | Gill nets. | | | | | |
|------------------------|------------------|--------|------|--------|------|--------|------------|--------|------|--------|------|--------|
| | 1918 | | 1919 | | 1920 | | 1918 | | 1919 | | 1920 | |
| | No. | Value. | No. | Value. | No. | Value. | No. | Value. | No. | Value. | No. | Value. |
| Bucksport..... | 1 | \$50 | 2 | \$125 | 2 | \$125 | | | | | | |
| Orland..... | 15 | 750 | 16 | 800 | 18 | 900 | | | | | | |
| Penobscot..... | 4 | 325 | 7 | 550 | 7 | 525 | | | | | | |
| Verona..... | 21 | 2,500 | 21 | 2,750 | 21 | 2,750 | | | | | | |
| Benzer and Brewer..... | | | | | | | 8 | \$80 | 8 | \$100 | 8 | \$100 |
| Hampden..... | 1 | 100 | 1 | 100 | 1 | 100 | 3 | 60 | 2 | 40 | 1 | 20 |
| Orrington..... | | | | | | | 6 | 120 | 6 | 120 | 6 | 120 |
| South Orrington..... | 2 | 255 | | | | | | | | | | |
| Lincolnville..... | 14 | 940 | 11 | 940 | 11 | 940 | | | | | | |
| Sandy Point..... | 4 | 475 | 4 | 475 | 4 | 475 | | | | | | |
| Winterport..... | 3 | 300 | 3 | 300 | 4 | 300 | | | | | | |
| Total..... | 62 | 5,695 | 65 | 6,040 | 68 | 6,175 | 17 | 260 | 16 | 260 | 15 | 240 |

EXTENT, BY LOCALITIES, OF THE SALMON FISHERY OF PENOBSCOT RIVER AND BAY
IN 1918, 1919, AND 1920—Continued.

| Town. | Rods and lines. | | | Gasoline boats. | | | | | |
|------------------------|-----------------|---------|---------|-----------------|--------|------|--------|------|--------|
| | 1918 | 1919 | 1920 | 1918 | | 1919 | | 1920 | |
| | Value. | Value. | Value. | No. | Value. | No. | Value. | No. | Value. |
| Orland..... | | | | 2 | \$150 | 2 | \$150 | 2 | \$150 |
| Verona..... | | | | 2 | 175 | 2 | 175 | 2 | 175 |
| Bangor and Brewer..... | \$900 | \$1,200 | \$1,500 | | | | | | |
| Hampden..... | | | | 2 | 300 | 2 | 300 | 1 | 100 |
| South Orrington..... | | | | 1 | 100 | | | | |
| Lincolnvile..... | | | | 1 | 150 | 1 | 150 | 1 | 150 |
| Sandy Point..... | | | | 1 | 125 | 1 | 125 | 1 | 125 |
| Winterport..... | | | | 1 | 100 | 1 | 100 | | |
| Total..... | 900 | 1,200 | 1,500 | 10 | 1,100 | 9 | 1,000 | 7 | 700 |

| Town. | Rowboats, etc. | | | | | | Shore and accessory property. | | | Total investment. | | |
|------------------------|----------------|--------|------|--------|------|--------|-------------------------------|-------|-------|-------------------|--------|--------|
| | 1918 | | 1919 | | 1920 | | 1918 | 1919 | 1920 | 1918 | 1919 | 1920 |
| | No. | Value. | No. | Value. | No. | Value. | | | | | | |
| Bucksport..... | 2 | \$35 | 4 | \$70 | 4 | \$70 | \$10 | \$20 | \$25 | \$95 | \$215 | \$220 |
| Orland..... | 19 | 385 | 19 | 385 | 20 | 400 | 150 | 150 | 150 | 1,435 | 1,485 | 1,600 |
| Penobscot..... | 6 | 85 | 8 | 115 | 8 | 115 | 40 | 55 | 60 | 450 | 720 | 700 |
| Verona..... | 20 | 440 | 20 | 440 | 20 | 440 | 175 | 150 | 150 | 3,290 | 3,515 | 3,515 |
| Bangor and Brewer..... | 23 | 1,060 | 23 | 1,060 | 23 | 1,060 | | | | 2,040 | 2,360 | 2,660 |
| Hampden..... | 3 | 105 | 3 | 105 | 3 | 105 | 550 | 550 | 550 | 1,115 | 1,095 | 875 |
| Orrington..... | 6 | 180 | 6 | 180 | 6 | 180 | | | | 300 | 300 | 300 |
| South Orrington..... | 4 | 130 | | | | | 50 | | | 535 | | |
| Lincolnvile..... | 7 | 340 | 7 | 340 | 7 | 340 | 150 | 150 | 150 | 1,580 | 1,580 | 1,580 |
| Sandy Point..... | 4 | 140 | 4 | 140 | 3 | 110 | 90 | 90 | 90 | 830 | 830 | 800 |
| Winterport..... | 4 | 140 | 4 | 140 | 1 | 25 | 190 | 190 | 190 | 730 | 730 | 575 |
| Total..... | 98 | 3,040 | 98 | 2,975 | 85 | 2,845 | 1,405 | 1,355 | 1,365 | 12,400 | 12,830 | 12,825 |

| Town. | Persons engaged. | | | Catch of salmon. ¹ | | | | | | | | |
|------------------------|------------------|------|--------|-------------------------------|--------|--------|-------|--------|--------|-------|--------|--------|
| | 1918 | 1919 | 1920 | 1918 | | | 1919 | | | 1920 | | |
| | No. | Lbs. | Value. | No. | Lbs. | Value. | No. | Lbs. | Value. | No. | Lbs. | Value. |
| Bucksport..... | 1 | 3 | 3 | 30 | 300 | \$105 | 48 | 480 | \$192 | 23 | 207 | \$98 |
| Orland..... | 13 | 14 | 16 | 56 | 560 | 191 | 55 | 550 | 225 | 94 | 846 | 372 |
| Penobscot..... | 3 | 4 | 4 | 240 | 2,400 | 807 | 181 | 1,810 | 773 | 259 | 2,331 | 1,127 |
| Verona..... | 11 | 11 | 11 | 609 | 6,090 | 2,188 | 421 | 4,210 | 1,605 | 636 | 5,724 | 2,465 |
| Bangor and Brewer..... | 31 | 31 | 31 | 115 | 1,380 | 307 | 133 | 1,330 | 568 | 140 | 1,540 | 832 |
| Hampden..... | 4 | 4 | 3 | 17 | 180 | 103 | 12 | 120 | 52 | 20 | 205 | 111 |
| Orrington..... | 12 | 12 | 12 | 80 | 880 | 91 | 120 | 1,200 | 511 | 45 | 495 | 266 |
| South Orrington..... | 2 | | | 70 | 770 | 188 | | | | | | |
| Lincolnvile..... | 6 | 6 | 6 | 148 | 1,480 | 544 | 105 | 1,050 | 525 | 124 | 1,116 | 558 |
| Sandy Point..... | 3 | 3 | 3 | 99 | 1,089 | 378 | 85 | 1,020 | 500 | 104 | 1,054 | 524 |
| Searsport..... | | | | | | | 10 | 100 | 50 | 21 | 189 | 95 |
| Stockton Springs..... | | | | 103 | 1,133 | 395 | 61 | 732 | 364 | 26 | 260 | 140 |
| Winterport..... | 3 | 3 | 4 | 86 | 950 | 203 | 91 | 955 | 406 | 106 | 1,168 | 622 |
| Total..... | 124 | 126 | 128 | 1,653 | 17,212 | 5,500 | 1,322 | 13,557 | 5,771 | 1,598 | 15,135 | 7,210 |

¹ The salmon credited to Orland in 1918, 1919, and 1920, and to Searsport in 1919 and 1920 were taken incidentally with apparatus fished for other species.

CATCH OF SALMON IN PENOBSCOT RIVER AND BAY FOR VARIOUS YEARS.

| Year. | Number. | Pounds. | Value. | Year. | Number. | Pounds. | Value. |
|-----------|---------|---------|----------|-----------|---------|---------|---------|
| 1895..... | 4,395 | 65,011 | \$11,356 | 1902..... | 3,269 | 45,782 | \$9,950 |
| 1896..... | 6,403 | 80,225 | 12,716 | 1903..... | 4,859 | 67,470 | 14,935 |
| 1897..... | 3,985 | 51,522 | 7,911 | 1904..... | 4,776 | 63,395 | 14,451 |
| 1898..... | 3,225 | 42,560 | 8,342 | 1905..... | 6,378 | 74,158 | 17,503 |
| 1899..... | 3,515 | 45,688 | 10,424 | 1918..... | 1,653 | 17,212 | 5,500 |
| 1900..... | 3,541 | 44,660 | 7,832 | 1919..... | 1,322 | 13,557 | 5,771 |
| 1901..... | 6,821 | 86,055 | 12,263 | 1920..... | 1,598 | 15,135 | 7,210 |

HUMPBACK SALMON.

In recent years humpback or pink salmon from the Pacific coast have been planted by the Bureau in the Dennys, Pembroke, St. Croix, Penobscot, and other rivers in Maine, beginning with the year 1906, and runs of adult fish have appeared during a number of years. The fish occurred in greatest abundance in the early autumn of 1919, when there were large runs in Dennys and Pembroke Rivers, and smaller runs in various other rivers. In July, 1919, a weir fisherman of Perry caught 17 humpback salmon in Little River and sold about 12 fish at \$1 each. They averaged from 4 to 6 pounds in weight. The total catch marketed in 1919 was 310 pounds, valued at \$62. Many were taken and released and probably a considerable number were consumed locally. There seems to be no doubt that this species, if properly protected, can maintain itself in certain New England rivers and become a valuable addition to the local fish supply.

INDUSTRIES.

Wholesale fishery trade.—In 1919, including one plant engaged solely in the production of liver oil, 99 firms engaged in the wholesale trade in fresh and salted fishery products, valued at \$1,722,094, using cash capital to the amount of \$274,550 and giving employment to 872 persons, to whom \$616,858 were paid in wages. As the preparation of by-products is for the most part conducted incidentally to activities in the wholesale trade, the canning and smoked fish industries, the prepared products have been listed under the respective industries. The following table gives the extent of the wholesale trade in fresh and salted fishery products of Maine in 1919:

WHOLESALE TRADE IN FRESH AND SALTED FISHERY PRODUCTS, BY COUNTIES.

| Item. | Cumberland. | | Hancock. | | Knox and Waldo. | |
|-------------------------|-------------|-----------|----------|-----------|-----------------|-------------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| Plants..... | 17 | \$346,928 | 35 | \$164,250 | 19 | \$1,053,906 |
| Cash capital..... | | 38,500 | | 49,000 | | 147,550 |
| Persons engaged..... | 149 | | 144 | | 145 | |
| Wages paid..... | | 124,393 | | 51,105 | | 398,993 |
| Products: | | | | | | |
| Liver oil.....gallons.. | 44,561 | 58,089 | 28,750 | 27,280 | 11,893 | 10,517 |
| Other products..... | | | | | | 44,587 |
| Total..... | | 58,089 | | 27,280 | | 55,104 |

| Item. | Lincoln, Penobscot, and York. | | Washington. | | Total. | |
|-------------------------|----------------------------------|----------|-------------|----------|---------|-------------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| Plants..... | 9 | \$96,160 | 19 | \$55,850 | 199 | \$1,722,094 |
| Cash capital..... | | 17,100 | | 22,400 | | 274,550 |
| Persons engaged..... | 42 | | 91 | | 872 | |
| Wages paid..... | | 23,638 | | 18,729 | | 616,858 |
| Products: | | | | | | |
| Liver oil.....gallons.. | 5,450 | 4,596 | | | 90,654 | 100,482 |
| Other products..... | | | | | | 44,587 |
| Total..... | | 4,596 | | | | 145,069 |

¹ Includes one plant engaged solely in production of liver oil.

Smoked-fish industry.—In 1919 there were 50 firms engaged primarily in smoking fishery products in Maine. These plants utilized 23,142,814 pounds of fishery products, valued at \$359,750.

The prepared products amounted to 4,415,582 pounds, valued at \$626,835. The most important items were: Boneless smoked herring, 1,729,219 pounds, valued at \$256,740; whole smoked herring, 1,141,278 pounds, valued at \$102,334; and finnan haddie, 785,333 pounds, valued at \$95,480. The value of the secondary products was \$73,687, which included 730 tons of fish scrap, valued at \$38,500; 1,271,424 pounds of pomace, valued at \$16,411; and 28,044 gallons of herring oil and liver oil, valued at \$18,664.

SMOKED-FISH INDUSTRY OF MAINE IN 1919.

| Item. | Number. | Value. | Item. | Number. | Value. |
|--------------------------|--------------|------------|-----------------------|-------------|-----------------------|
| Plants..... | 1 50 | \$716, 589 | PRODUCTS—continued. | | |
| Cost of materials..... | | 109, 577 | Prepared—Continued. | | |
| Cash capital..... | | 131, 700 | Kipperd herring, | | |
| Persons engaged..... | 707 | | pounds..... | *156, 500 | \$15, 845 |
| Wages paid..... | | 260, 179 | Smoked herring— | | |
| PRODUCTS. | | | Bloaters...pounds.. | 327, 330 | 20, 629 |
| Utilized: | | | Lengthwise...do.... | 37, 053 | 2, 511 |
| Alewives.....pounds.. | 650 | 26 | Medium scale, | | |
| Cod,salted,dried.do.... | 569, 055 | 60, 970 | pounds..... | 238, 534 | 13, 036 |
| Haddock.....do.... | 8, 122, 798 | 192, 485 | Boneless...pounds.. | 1, 729, 219 | 256, 740 |
| Herring.....do.... | | | Whole.....do.... | 1, 141, 278 | 102, 334 |
| Fresh.....do.... | 9, 575, 127 | 69, 629 | Other products..... | | ⁶ 120, 200 |
| Smoked.....do.... | 247, 000 | 12, 712 | Total..... | 4, 415, 582 | 626, 835 |
| Fish skins, waste, etc., | | | Secondary: | | |
| pounds..... | 3, 228, 184 | 10, 928 | Oil— | | |
| Pomace.....pounds.. | 1, 400, 000 | 13, 000 | Herring....gallons.. | 23, 171 | 14, 086 |
| Total..... | 23, 142, 814 | 359, 750 | Liver.....do.... | 4, 573 | 4, 578 |
| Prepared: | | | Pomace.....pounds.. | 1, 271, 424 | 16, 411 |
| Smoked alewives, | | | Fish scrap.....do.... | 1, 460, 000 | 38, 500 |
| pounds..... | 335 | 60 | Other products..... | | 112 |
| Finnan haddie, | | | Total..... | | 73, 687 |
| pounds..... | * 785, 333 | 95, 480 | | | |

¹ Includes one firm in Cumberland County and three in Washington County also engaged in making herring oil, pomace, and fish scrap.

² All smoked herring under products utilized were imported from Canada and used for preparing boneless herring.

³ Includes the output of one plant in Penobscot County and two in Cumberland County listed with canners.

⁴ Includes the output of one plant in Penobscot County listed with canners.

⁵ Includes the value of herring pickled by one firm in Washington County.

Canning industry.—The canning industry of Maine is of growing importance, the chief products packed being sardines, finnan haddie, and clams. In 1919, 77 plants were operated, representing a value of \$4,315,878 and employing cash or working capital to the amount of \$625,257. The cost of materials amounted to \$4,768,040; the number of persons employed was 6,116, to whom \$1,795,506 were paid in wages; and the value of the products utilized was \$1,145,614, of which the most important were: Herring, 128,163,663 pounds, valued at \$875,627; haddock, 6,983,629 pounds, valued at \$149,496; and soft clams, 1,801,070 pounds, valued at \$119,083. It is of interest to note that 19,670 bushels of mussels were utilized, and it is believed that the work of the Bureau in encouraging the use of this product has aided in the development of this fishery. The manufactured products included 2,774,656 cases of canned products, valued at \$13,086,886, and secondary products such as scrap, meal, and oil to the value of \$82,328. The canned products included 2,450,268 cases of sardines, valued at \$11,933,986; 228,127 cases of finnan haddie, valued at \$603,696, and 85,426 cases of clam products, valued at \$439,221.

The clam pack represents the output of nine firms in Washington County, five in Cumberland County, nine in Hancock County, four in Knox County, two in Lincoln County, one in Penobscot County, and one in York County. Of these firms, seven also canned sardines, one mussels, and three smoked fish. As it has been found impracticable to show the pack of clams by grades and counties without disclosing private enterprise, the pack in detailed form has been omitted from the appended table. The pack was made up of the following items: 259 cases of clams in 4-ounce containers, valued at \$1,471; 24,935 cases of 5-ounce cans, valued at \$113,373; 2,954 cases of 6-ounce cans, valued at \$10,930; 6,641 cases of 8-ounce cans, valued at \$49,847; 679 cases of 8½-ounce cans, valued at \$3,058; 4,406 cases of 10-ounce cans, valued at \$20,730; 200 cases of 11-ounce cans, valued at \$760; 19,234 cases of 1-pound cans, valued at \$115,068; 4,199 cases of 2-pound cans, valued at \$25,194; 1,327 cases of No. 3 cans, valued at \$6,348; 74 cases of clam juice in 5-ounce cans, valued at \$222; 3,843 cases of clam juice in 10-ounce cans, valued at \$4,903; 16 cases in No. 1 cans, valued at \$48; 503 cases in No. 10 cans, valued at \$946; and 16,156 cases of clam chowder and bouillon in containers of various sizes, valued at \$86,323.

CANNING INDUSTRY OF MAINE IN 1919, BY COUNTIES.

| Item. | Cumberland. | | Hancock. | | Knox and Waldo. | |
|--|-------------|-----------|------------|-----------|-----------------|-----------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| Plants..... | 9 | \$591,262 | 17 | \$469,590 | 8 | \$240,537 |
| Cost of materials..... | | 394,446 | | 756,025 | | 194,373 |
| Cash capital..... | | 337,107 | | 57,550 | | 55,070 |
| Persons engaged..... | 569 | | 958 | | 377 | |
| Wages paid..... | | 179,780 | | 317,380 | | 111,347 |
| PRODUCTS. | | | | | | |
| Utilized: | | | | | | |
| Cod.....pounds..... | | | 4,320 | 86 | | |
| Haddock.....do..... | 6,983,629 | 149,496 | | | | |
| Herring.....do..... | 3,452,898 | 35,572 | 21,325,259 | 152,271 | 5,424,020 | 30,945 |
| Clams, soft.....do..... | 48,360 | 3,444 | 637,770 | 37,984 | 184,910 | 11,907 |
| Clams, soft, steamed.....do..... | | | 167,300 | 9,189 | | |
| Mussels.....bushels..... | | | | | 19,670 | 367 |
| Canned: ¹ | | | | | | |
| Sardines— | | | | | | |
| In oil—Quarters.....cases.. | 57,071 | 452,237 | 314,909 | 1,754,761 | 71,769 | 369,714 |
| In mustard— | | | | | | |
| Quarters.....do..... | 1,340 | 6,164 | 9,434 | 43,559 | 1,406 | 6,467 |
| Halves.....do..... | | | 7,862 | 66,000 | | |
| Three-quarters.....do..... | 12,331 | 52,477 | 47,882 | 258,025 | 8,871 | 39,357 |
| In tomato sauce— | | | | | | |
| Quarters.....do..... | 1,225 | 7,446 | 11,458 | 60,962 | 1,302 | 6,764 |
| Halves.....do..... | 1,071 | 10,280 | | | 2,816 | 28,732 |
| 1 pound.....do..... | 811 | 9,732 | | | 26 | 312 |
| Plain—Halves.....do..... | 356 | 2,631 | | | | |
| Finnan haddie— | | | | | | |
| 4-ounce.....do..... | 197,546 | 486,134 | | | | |
| 8-ounce.....do..... | 25 | 325 | | | | |
| 10-ounce.....do..... | 29,378 | 111,628 | | | | |
| 1 pound.....do..... | 1,178 | 5,529 | | | | |
| Total..... | 302,532 | 1,144,663 | 391,545 | 2,183,307 | 86,190 | 451,286 |
| Secondary: Fish scrap and meal, pounds..... | | | | | 356,200 | 14,886 |
| Grand total..... | | 1,144,663 | | 2,183,307 | | 466,172 |

¹ Steamed by the fishermen.² Sardine quarters are packed 100 cans to the case and other sardines usually 48 cans to the case, except half-pint cans, which sometimes contain 72 cans per case. The number of cans per case of canned clams vary as follows: The 6-oz., 8½-oz., 10-oz., 11-oz., 2-lb., and No. 3 average 2 dozen per case, while the 4-oz., 5-oz., 8-oz., and 1-lb. average 4 dozen per case. The clam juice, 5-oz., 10-oz., and No. 1 cans, average 2 dozen per case, and the No. 10 are packed one-half dozen to the case. The one-half pound kippered herring are packed 8 dozen to the case, and the 1-lb. cans are packed 4 and 6 dozen to the case.

CANNING INDUSTRY OF MAINE IN 1919, BY COUNTIES—Continued.

| Item. | Lincoln, Penobscot, and York. | | Washington. | | Total. | |
|-------------------------------------|----------------------------------|----------|-------------|-------------|-------------|-------------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| Plants..... | 4 | \$84,023 | 139 | \$2,930,466 | 77 | \$4,315,878 |
| Cost of materials..... | | 15,873 | | 3,497,323 | | 4,768,040 |
| Cash capital..... | | 21,430 | | 154,100 | | 625,257 |
| Persons engaged..... | 106 | | 4,106 | | 6,116 | |
| Wages paid..... | | 18,213 | | 1,168,786 | | 1,795,506 |
| PRODUCTS. | | | | | | |
| Utilized: | | | | | | |
| Cod.....pounds..... | | | 36,016 | 955 | 40,336 | 1,041 |
| Haddock.....do..... | | | | | 6,983,629 | 149,496 |
| Herring.....do..... | 101,553 | 1,800 | 97,859,933 | 655,039 | 128,163,663 | 875,627 |
| Clams, soft.....do..... | 134,190 | 9,582 | 727,970 | 46,977 | 1,733,770 | 109,894 |
| Clams, soft, steamed.....do..... | | | | | 67,300 | 9,189 |
| Mussels.....bushels..... | | | | | 19,670 | 367 |
| Canned: ¹ | | | | | | |
| Sardines— | | | | | | |
| In oil— | | | | | | |
| Quarters.....cases..... | | | 1,458,681 | 6,750,953 | 1,902,430 | 9,327,665 |
| Halves.....do..... | | | 878 | 11,500 | 878 | 11,500 |
| In mustard— | | | | | | |
| Quarters.....do..... | | | 115,484 | 546,607 | 127,664 | 602,797 |
| Halves.....do..... | | | | | 7,862 | 66,000 |
| Three-quarters.....do..... | | | 242,363 | 973,555 | 311,647 | 1,323,414 |
| In tomato sauce— | | | | | | |
| Quarters.....do..... | | | 76,407 | 457,073 | 90,392 | 532,185 |
| Halves.....do..... | | | 1,166 | 5,522 | 5,053 | 44,534 |
| 1 pound.....do..... | | | 1,334 | 6,413 | 2,171 | 16,457 |
| Plain— | | | | | | |
| Halves.....do..... | | | 127 | 490 | 483 | 3,121 |
| No. 1.....do..... | | | 1,688 | 6,313 | 1,688 | 6,313 |
| Kipperd herring— | | | | | | |
| Half pound.....do..... | | | | | 1,917 | 15,386 |
| 1 pound.....do..... | | | | | 7,631 | 86,385 |
| Finnan haddie— | | | | | | |
| 6½-ounce.....do..... | | | | | 197,546 | 486,134 |
| 8-ounce.....do..... | | | | | 25 | 325 |
| 10½-ounce.....do..... | | | | | 29,378 | 111,638 |
| 1 pound.....do..... | | | | | 1,178 | 5,599 |
| Clams (various sizes).....do..... | | | | | 85,426 | 439,221 |
| Miscellaneous.....do..... | | | | | 1,287 | 8,212 |
| Total..... | | | 1,898,128 | 8,758,426 | 2,774,656 | 13,086,886 |
| Secondary: | | | | | | |
| Fish scrap and meal.....pounds..... | | | 1,972,000 | 66,959 | 2,328,200 | 81,845 |
| Herring oil.....gallons..... | | | 690 | 483 | 690 | 483 |
| Total..... | | | | 67,442 | | 82,328 |
| Grand total..... | | | | 8,825,868 | | 13,169,214 |

¹ This includes one plant located at Belfast, in Waldo County.² See footnote 2 on p. 149.

Sardine industry in 1919 and 1920.—In 1919, 53 plants were engaged in canning sardines, employing 5,463 persons, to whom \$1,685,409 were paid in wages. The plants were valued at \$3,764,875, the cost of materials used was \$4,556,963, and the working capital amounted to \$256,107. The herring utilized amounted to 125,309,415 pounds, valued at \$852,450. The total pack was 2,450,268 cases, valued at \$11,933,986, of which 1,902,430 cases, valued at \$9,327,665, were quarter oils.

In 1920 the number of plants operated was 50, valued at \$3,816,388; the cost of materials amounted to \$3,907,878; the working capital was \$250,000; and the number of persons employed was 5,109, to

whom \$1,787,402 were paid in wages. The herring utilized amounted to 104,700,010 pounds, valued at \$767,141, and the pack was 1,877,757 cases, valued at \$7,435,056, of which 1,458,670 cases, valued at \$5,669,352, were quarter oils.

The detailed statistics of the sardine industry of Maine in 1919 and 1920, by counties, are shown in the appended tables:

SARDINE INDUSTRY OF MAINE IN 1919 AND 1920, BY COUNTIES.

1919.

| Item. | Cumberland. | | Hancock. | | Knox and Waldo. | |
|--------------------------------------|----------------|----------------|----------------|------------------|-----------------|----------------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| Plants..... | 5 | \$172,673 | 10 | \$456,090 | 5 | \$225,146 |
| Cost of material..... | | 241,504 | | 741,150 | | 185,186 |
| Cash capital..... | | 26,107 | | 46,000 | | 40,000 |
| Persons engaged..... | 392 | | 832 | | 235 | |
| Wages paid..... | | 128,187 | | 303,621 | | 100,769 |
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Herring utilized..... | 3,395,203 | \$34,992 | 21,325,259 | \$152,271 | 5,424,020 | \$30,945 |
| Canned sardines: ¹ | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| In oil— | 57,071 | \$452,237 | 314,909 | \$1,754,761 | 71,769 | \$369,714 |
| Quarters..... | | | | | | |
| Halves..... | | | | | | |
| In mustard— | | | | | | |
| Quarters..... | 1,340 | 6,164 | 9,434 | 43,559 | 1,406 | 6,467 |
| Halves..... | | | 7,962 | 66,600 | | |
| Three-quarters..... | 12,531 | 52,477 | 47,882 | 258,025 | 8,871 | 39,357 |
| In tomato sauce— | | | | | | |
| Quarters..... | 1,225 | 7,446 | 11,458 | 60,962 | 1,302 | 6,704 |
| Halves..... | 1,071 | 10,280 | | | 2,816 | 28,732 |
| One pound..... | 811 | 9,732 | | | 26 | 312 |
| Plain— | | | | | | |
| Half-pound..... | 356 | 2,631 | | | | |
| Number one..... | | | | | | |
| Total sardines..... | 74,405 | 540,967 | 391,545 | 2,183,307 | 86,190 | 451,286 |

| Item. | Washington. | | Total. | |
|--------------------------------------|------------------|------------------|------------------|-------------------|
| | Number. | Value. | Number. | Value. |
| Plants..... | 133 | \$2,910,966 | 53 | \$3,764,875 |
| Cost of material..... | | 3,389,123 | | 4,556,963 |
| Cash capital..... | | 144,000 | | 256,107 |
| Persons engaged..... | 4,004 | | 5,463 | |
| Wages paid..... | | 1,152,832 | | 1,685,409 |
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. |
| Herring utilized..... | 95,164,933 | \$634,242 | 125,309,115 | \$852,450 |
| Canned sardines: ² | Cases. | Value. | Cases. | Value. |
| In oil— | 1,458,681 | \$6,750,953 | 1,902,430 | \$9,327,665 |
| Quarters..... | | | | |
| Halves..... | 878 | 11,500 | 878 | 11,500 |
| In mustard— | | | | |
| Quarters..... | 115,484 | 546,607 | 127,664 | 602,797 |
| Halves..... | | | 7,962 | 66,600 |
| Three-quarters..... | 242,363 | 973,555 | 311,647 | 1,323,414 |
| In tomato sauce— | | | | |
| Quarters..... | 76,407 | 457,073 | 90,392 | 532,185 |
| Halves..... | 1,166 | 5,522 | 5,033 | 44,534 |
| One pound..... | 1,334 | 6,413 | 2,171 | 16,457 |
| Plain— | | | | |
| Half-pound..... | 127 | 490 | 483 | 3,121 |
| Number one..... | 1,688 | 6,313 | 1,688 | 6,313 |
| Total sardines..... | 1,898,128 | 8,758,426 | 2,450,268 | 11,933,986 |

¹ Includes one plant located at Belfast, in Waldo County.

² Quarters are packed 109 cans to the case and others usually 48 cans to the case, except half-pound ovals, which sometimes contain 72 cans to the case.

SARDINE INDUSTRY OF MAINE IN 1919 AND 1920, BY COUNTIES—Continued.

1920.

| Item. | Cumberland. | | Hancock. | | Knox and Waldo. | |
|-------------------------------|----------------|---------------|----------------|---------------|-----------------|---------------|
| | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> |
| Plants..... | 6 | \$204, 132 | 8 | \$567, 643 | 3 | \$245, 009 |
| Cost of material..... | | 133, 071 | | 392, 975 | | 81, 772 |
| Cash capital..... | | 37, 000 | | 37, 000 | | 6, 500 |
| Persons engaged..... | 432 | | 649 | | 171 | |
| Wages paid..... | | 89, 285 | | 169, 752 | | 64, 520 |
| PRODUCTS. | | | | | | |
| Herring utilized..... | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| | 3, 073, 468 | \$30, 114 | 9, 878, 319 | \$80, 701 | 2, 034, 800 | \$15, 915 |
| Canned sardines: ¹ | | | | | | |
| In oil— | <i>Cases.</i> | <i>Value.</i> | <i>Cases.</i> | <i>Value.</i> | <i>Cases.</i> | <i>Value.</i> |
| Quarters..... | 36, 510 | \$206, 232 | 142, 985 | \$789, 168 | 22, 077 | \$149, 628 |
| Halves..... | | | 2, 228 | 22, 280 | | |
| In mustard— | | | | | | |
| Quarters..... | 1, 226 | 4, 523 | 6, 261 | 31, 824 | 51 | 204 |
| Three-quarters..... | 5, 492 | 16, 650 | 18, 067 | 89, 842 | 785 | 3, 242 |
| In tomato sauce— | | | | | | |
| Quarters..... | 3, 317 | 15, 155 | 6, 143 | 25, 499 | 2, 949 | 11, 796 |
| Halves..... | 150 | 1, 080 | | | 1, 331 | 15, 956 |
| Three-quarters..... | | | | | | |
| One pound..... | 18, 075 | 75, 846 | | | 3, 712 | 33, 408 |
| Total sardines..... | 64, 770 | 319, 486 | 175, 684 | 958, 613 | 30, 905 | 214, 234 |

| Item. | Washington. | | Total. | |
|-------------------------------|-----------------|---------------|----------------|---------------|
| | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> |
| Plants..... | ¹ 33 | \$2, 790, 604 | 50 | \$3, 816, 388 |
| Cost of material..... | | 3, 300, 060 | | 3, 907, 878 |
| Cash capital..... | | 169, 500 | | 250, 000 |
| Persons engaged..... | 3, 837 | | 5, 109 | |
| Wages paid..... | | 1, 463, 845 | | 1, 787, 402 |
| PRODUCTS. | | | | |
| Herring utilized..... | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| | 89, 713, 423 | \$640, 411 | 104, 700, 010 | \$767, 141 |
| Canned sardines: ² | | | | |
| In oil— | <i>Cases.</i> | <i>Value.</i> | <i>Cases.</i> | <i>Value.</i> |
| Quarters..... | 1, 237, 098 | \$4, 524, 324 | 1, 458, 670 | \$5, 669, 352 |
| Halves..... | | | 2, 228 | 22, 280 |
| In mustard— | | | | |
| Quarters..... | 43, 945 | 185, 493 | 51, 483 | 222, 044 |
| Three-quarters..... | 158, 625 | 586, 330 | 182, 969 | 696, 064 |
| In tomato sauce— | | | | |
| Quarters..... | 145, 905 | 641, 832 | 158, 314 | 694, 282 |
| Halves..... | | | 1, 481 | 17, 036 |
| Three-quarters..... | 348 | 1, 643 | 348 | 1, 643 |
| One pound..... | 477 | 3, 101 | 22, 264 | 112, 355 |
| Total sardines..... | 1, 606, 398 | 5, 942, 723 | 1, 877, 757 | 7, 435, 056 |

¹ Includes two plants located in Waldo County.² Quarters are packed 100 cans to the case and others usually 48 cans to the case, except half-pound ovals, which sometimes contain 72 cans to the case.

FISHERIES OF NEW HAMPSHIRE.

The coastal fisheries of New Hampshire are unimportant in comparison with the fisheries of the other New England States and are confined to Rockingham County, the only coastal county. In 1919 the number of persons employed was 100, of whom 3 were on a vessel transporting fishery products, 85 in the shore and boat fisheries, and 12 shoresmen in wholesale fish establishments. The amount of capital invested was \$45,530 and included: A transporting vessel with outfit, valued at \$9,300; 31 small boats, valued at \$802; 53 power boats, valued at \$10,675; fishing apparatus in the shore fish-

eries to the value of \$7,295; shore and accessory property with a value of \$11,958, and cash capital amounting to \$5,500.

The products amounted to 528,730 pounds, valued at \$92,660. The species of chief importance were as follows: Lobsters, 298,012 pounds, valued at \$73,203; soft clams, 66,600 pounds, valued at \$13,320; and cod, 98,354 pounds, valued at \$3,609.

Compared with 1905, there has been a decrease of 45 in the number of persons employed, of \$1,520 in the capital invested, and of 507,722 pounds in the quantity of products; but an increase in the value of the products of \$40,716. There has been an increase in the catch of lobsters as compared with 1905 of 41,960 pounds in quantity and \$40,628 in value and a decrease in the collection of Irish moss of 54,000 pounds in quantity and \$1,980 in the value.

FISHERIES OF ROCKINGHAM COUNTY.

The following table shows the number of persons employed, the investment, and the quantity and value of the products of the fisheries of Rockingham County, N. H., in 1919:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF ROCKINGHAM COUNTY, N. H., IN 1919.

| Item. | Number. | Value. | Item. | Number. | Value. |
|-------------------------------|---------|---------|-----------------------------------|---------|----------|
| PERSONS ENGAGED. | | | INVESTMENT—continued. | | |
| On vessels transporting..... | 3 | ..... | Shore and accessory property..... | | \$11,958 |
| Inshore fisheries..... | 85 | ..... | Cash capital..... | | 5,500 |
| Shoresmen..... | 12 | ..... | Total..... | | 45,530 |
| Total..... | 100 | ..... | PRODUCTS. | | |
| INVESTMENT. | | | | Pounds. | Value. |
| Vessel transporting: Gasoline | 1 | \$6,300 | Cod..... | 98,354 | 3,609 |
| Tonnage..... | 8 | ..... | Cusk..... | 2,400 | 86 |
| Outfit..... | | 3,000 | Eels..... | 2,000 | 240 |
| Boats: | | | Flounders..... | 8,000 | 240 |
| Sail, row, etc..... | 31 | 802 | Haddock..... | 18,764 | 829 |
| Power..... | 53 | 10,675 | Hake..... | 3,000 | 98 |
| Apparatus, shore fisheries: | | | Pollock..... | 25,600 | 615 |
| Handline..... | | 70 | Lobsters..... | 298,012 | 73,203 |
| Trawl lines..... | | 392 | Clams, soft..... | 66,600 | 13,320 |
| Lobster pots..... | 2,275 | 6,735 | Irish moss..... | 6,000 | 420 |
| Eel pots..... | 18 | 36 | Total..... | 528,730 | 92,660 |
| Clam hoes..... | 25 | 50 | | | |
| Moss rakes..... | 2 | 12 | | | |

¹ 6,600 bushels.

FISHERIES BY APPARATUS.

No vessels were employed in the capture of fish in 1919. The largest quantity in the shore fisheries, consisting of 298,012 pounds of lobsters, valued at \$73,203, was taken with lobster pots. The catch with hand lines, amounting to 156,118 pounds, valued at \$5,477, was second, and the catch of soft clams with clam hoes, third. The principal species taken with hand lines were cod, pollock, haddock, and flounders. The following table gives the products of the shore fisheries in 1919 by apparatus and species:

YIELD OF THE SHORE FISHERIES OF NEW HAMPSHIRE IN 1919, BY APPARATUS AND SPECIES.

| Apparatus and species. | Pounds. | Value. | Apparatus and species. | Pounds. | Value. |
|------------------------|---------|---------|-----------------------------|---------|----------|
| Lines: | | | Lobster pots: Lobsters..... | 298,012 | \$73,203 |
| Cod..... | 98,354 | \$3,609 | Eel pots: Eels..... | 2,000 | 240 |
| Cusk..... | 2,400 | 86 | Clam hoes: Soft clams..... | 66,600 | 13,320 |
| Flounders..... | 8,000 | 240 | Moss rakes: Irish moss..... | 6,000 | 420 |
| Haddock..... | 18,764 | 829 | Grand total..... | 528,730 | 92,660 |
| Hake..... | 3,000 | 98 | | | |
| Pollock..... | 25,600 | 615 | | | |
| Total..... | 156,118 | 5,477 | | | |

WHOLESALE FISHERY TRADE.

There were only 2 wholesale fresh-fish establishments in Rockingham County in 1919, valued at \$7,540, using cash capital to the amount of \$5,500 and employing 12 persons, to whom \$12,678 were paid in wages.

FISHERIES OF MASSACHUSETTS.

The fisheries of Massachusetts in 1919 were more productive than those of all the other New England States combined. The number of persons employed was 12,346, of whom 4,459 were on fishing vessels, 66 on vessels transporting fishery products, 3,737 in the shore and boat fisheries, and 4,084 shoresmen in the wholesale plants, canneries, salteries, smokehouses, by-products plants, and other shore establishments.

The investment included 421 fishing and transporting vessels, valued at \$6,192,118, having a net tonnage of 16,838 tons and outfits valued at \$1,860,766; 3,040 power, sail, row, and other small boats, valued at \$949,683; apparatus employed in the vessel and boat fisheries to the value of \$1,205,518; shore and accessory property valued at \$7,000,239, and cash capital to the amount of \$1,902,945, making a total investment of \$19,111,269.

The products of the fisheries amounted to 246,951,241 pounds, valued at \$10,859,746. The most important species arranged in the order of their value were: Cod, 69,496,325 pounds, valued at \$2,992,793; haddock, 78,178,384 pounds, valued at \$2,208,211; common mackerel, 13,516,194 pounds, valued at \$1,322,409; lobsters, 2,387,636 pounds, valued at \$516,393; flounders, 10,262,693 pounds, valued at \$478,850; pollock, 19,242,541 pounds, valued at \$469,943; and scallops, 1,332,486 pounds, or 222,081 bushels, valued at \$439,382.

Compared with the Bureau's returns for 1905 there has been a decrease in the number of persons employed of 3,348, an increase in the investment amounting to \$8,300,827, a decrease in the quantity of products taken amounting to 8,703,234 pounds, and an increase in the value amounting to \$3,834,497. The species for which there has been a notable increase in 1919 as compared with 1905, with the amount of increase follow: Flounders, 6,219,010 pounds; squid, 5,348,807 pounds; whiting, 9,618,960 pounds; lobsters, 1,104,565 pounds; scallops, 1,069,249 pounds; and hard crabs, 1,704,961 pounds. Those for which there has been a marked decrease as compared with 1905 are: Alewives, 1,673,820 pounds; cusk, 5,877,991 pounds; hake, 16,605,435 pounds; halibut, 1,796,447 pounds; and herring, 7,553,045 pounds.

FISHERIES BY COUNTIES.

The statistics of the number of persons employed, investment, and products of the fisheries in Massachusetts in 1919 are given by counties in the appended table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES.

| Item. | Barnstable. | | Bristol. | | Dukes. | |
|---------------------------------------|-------------|-----------|----------|----------|---------|----------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| PERSONS ENGAGED. | | | | | | |
| On vessels fishing..... | 504 | | 218 | | 54 | |
| On vessels transporting..... | 6 | | | | | |
| Inshore fisheries..... | 1,386 | | 355 | | 229 | |
| Shoresmen..... | 688 | | 169 | | 34 | |
| Total..... | 2,584 | | 742 | | 317 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Steam..... | 1 | \$12,000 | | | | |
| Tonnage..... | 55 | | | | | |
| Outfit..... | | 4,400 | | | | |
| Gasoline..... | 68 | 186,150 | 15 | \$52,500 | 14 | \$59,100 |
| Tonnage..... | 626 | | 160 | | 128 | |
| Outfit..... | | 88,940 | | 24,900 | | 16,210 |
| Sail..... | 12 | 139,500 | 6 | 98,200 | | |
| Tonnage..... | 1,299 | | 829 | | | |
| Outfit..... | | 126,525 | | 24,200 | | |
| Vessels transporting: | | | | | | |
| Gasoline..... | 3 | 8,500 | | | | |
| Tonnage..... | 17 | | | | | |
| Outfit..... | | 450 | | | | |
| Boats: | | | | | | |
| Sail, row, etc..... | 633 | 39,000 | 149 | 3,145 | 70 | 3,043 |
| Power..... | 500 | 238,770 | 161 | 43,375 | 167 | 74,125 |
| Apparatus, vessel fisheries: | | | | | | |
| Purse seines..... | 15 | 32,800 | 8 | 3,650 | 3 | 2,100 |
| Gill nets..... | 661 | 13,835 | 340 | 5,550 | 555 | 10,080 |
| Otter trawls..... | 35 | 2,645 | 4 | 300 | 5 | 300 |
| Lines, hand and trawl..... | | 8,294 | | 960 | | 2,694 |
| Harpoons..... | | 800 | | 925 | | 725 |
| Lobster pots..... | 75 | 150 | 80 | 200 | 275 | 700 |
| Dredges..... | 158 | 1,571 | 2 | 30 | 12 | 60 |
| Tongs..... | | | 1 | 9 | | |
| Whaling apparatus..... | | 12,000 | | 17,000 | | |
| Apparatus, shore fisheries: | | | | | | |
| Purse seines..... | 4 | 2,600 | | | 1 | 150 |
| Haul seines..... | 13 | 1,085 | 6 | 415 | 3 | 540 |
| Gill nets..... | 881 | 13,370 | 20 | 275 | 40 | 640 |
| Pound nets, trap nets, and weirs..... | 151 | 326,700 | 18 | 8,200 | 31 | 22,100 |
| Fyke nets..... | 44 | 1,010 | 7 | 475 | 2 | 100 |
| Bow nets..... | 13 | 36 | | | | |
| Dip nets..... | 63 | 138 | | | | |
| Otter trawls..... | 36 | 1,970 | 2 | 170 | 52 | 2,875 |
| Lines, hand and trawl..... | | 10,250 | | 152 | | 91 |
| Harpoons..... | | | | 60 | | 480 |
| Spears..... | 27 | 51 | 29 | 83 | | |
| Cunner traps..... | | | 4 | 6 | | |
| Cockle traps..... | 400 | 360 | | | | |
| Lobster pots..... | 2,750 | 5,549 | 7,352 | 15,762 | 5,543 | 15,661 |
| Eel pots..... | 738 | 1,503 | 55 | 100 | 587 | 1,545 |
| Dredges..... | 1,086 | 7,561 | 256 | 1,280 | 416 | 2,080 |
| Tongs..... | 115 | 674 | 70 | 390 | | |
| Rakes..... | 537 | 2,219 | 92 | 1,054 | 54 | 1,080 |
| Forks and hoes..... | 139 | 286 | 1 | 1 | 7 | 14 |
| Shore and accessory property..... | | 1,492,266 | | 124,035 | | 66,405 |
| Cash capital..... | | 83,650 | | 16,000 | | 9,000 |
| Total..... | | 2,867,608 | | 443,402 | | 291,898 |
| PRODUCTS. | | | | | | |
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives: | | | | | | |
| Fresh..... | 313,466 | \$5,634 | 104,795 | \$2,075 | 551,150 | \$14,141 |
| Salted..... | 801,600 | 35,629 | 60,534 | 2,220 | 140,090 | 6,390 |
| Smoked..... | 39,000 | 2,845 | | | | |
| Bluefish..... | 3,932 | 696 | | | 121 | 24 |
| Bonito..... | 33,956 | 2,519 | 40 | 4 | 95,461 | 9,929 |
| Butterfish..... | 180,500 | 15,577 | 11,700 | 850 | 56,899 | 5,853 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.

| Item. | Barnstable. | | Bristol. | | Dukes. | |
|---------------------------|-------------|-----------|-----------|----------|-----------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| PRODUCTS continued. | | | | | | |
| Catfish and wolffish..... | 20,976 | \$330 | | | | |
| Cod: | | | | | | |
| Fresh..... | 6,132,372 | 229,207 | 176,870 | \$10,697 | 201,250 | \$14,313 |
| Salted..... | 6,500 | 450 | | | | |
| Cannery..... | | | 7,150 | 500 | | |
| Cusk, fresh..... | 16,428 | 436 | | | | |
| Eels..... | 112,708 | 16,912 | 24,778 | 2,880 | 79,500 | 11,505 |
| Flounders..... | 3,979,872 | 161,782 | 187,123 | 9,058 | 913,238 | 59,457 |
| Grayfish..... | 1,000 | 10 | 62,667 | 174 | | |
| Gonosefish..... | | | 2,506 | 7 | | |
| Haddock, fresh..... | 5,865,917 | 172,356 | | | 65,551 | 4,553 |
| Hake, fresh..... | 644,902 | 15,839 | 2,763 | 180 | 15,086 | 1,501 |
| Halibut, fresh..... | 19,318 | 4,385 | 20,000 | 5,000 | | |
| Herring..... | 6,445,441 | 80,284 | 88,765 | 1,373 | 25 | 3 |
| Hickory shad..... | 11,650 | 780 | 1,150 | 50 | | |
| Kingfish..... | | | 72 | 18 | | |
| Launce..... | 67,800 | 888 | | | | |
| Mackerel: | | | | | | |
| Fresh..... | 3,596,851 | 337,779 | 263,445 | 26,526 | 335,337 | 41,320 |
| Frigate..... | | | | | 61,361 | 1,862 |
| Menhaden..... | 69,303 | 1,605 | 46,516 | 272 | 5,400 | 54 |
| Minnows..... | 1,000 | 125 | | | | |
| Perch, white..... | | | 200 | 20 | 6,000 | 900 |
| Pollock, fresh..... | 1,242,907 | 29,719 | 140 | 5 | 45,871 | 1,398 |
| Pompano..... | 14 | 2 | | | | |
| Rosefish..... | 305 | 9 | | | | |
| Round herring..... | 941 | 19 | | | | |
| Sculpin..... | | | 6,000 | 15 | | |
| Scup..... | 10,344 | 759 | 52 | 6 | 65,278 | 4,626 |
| Sea bass..... | 345 | 110 | 2,289 | 50 | 10,365 | 1,182 |
| Sea robin..... | | | 400 | 1 | | |
| Shad..... | 5,645 | 1,553 | 352 | 85 | 37 | 7 |
| Sharks..... | 314,525 | 3,220 | 3,175 | 71 | | |
| Skates and rays..... | 885 | 17 | 93,649 | 381 | | |
| Smelt..... | 257 | 38 | 97 | 13 | | |
| Squeteague..... | 613 | 74 | 962 | 151 | 4,202 | 683 |
| Striped bass..... | 307 | 115 | 605 | 103 | 59 | 13 |
| Sturgeon..... | 5,183 | 1,191 | | | | |
| Sturgeon caviar..... | 30 | 85 | | | | |
| Sturgeon roe..... | 175 | 150 | | | | |
| Swordfish..... | 112,935 | 20,860 | 109,141 | 22,865 | 121,538 | 25,740 |
| Tautog..... | 35,427 | 2,589 | 49,369 | 5,421 | 822 | 49 |
| Tilefish..... | | | 38,060 | 1,330 | | |
| Tomcod..... | 2,200 | 6 | 4,690 | 183 | | |
| Tuna..... | 37,048 | 2,716 | 53 | 2 | | |
| Whiting..... | 11,173,383 | 135,485 | 57,709 | 948 | 62,727 | 365 |
| Other species..... | 9,500 | 100 | 8,411 | 388 | 20,321 | 1,629 |
| Squid..... | 5,837,988 | 104,364 | 141,129 | 2,184 | 16,459 | 253 |
| Blackfish..... | 40,000 | 40 | | | | |
| Porpoise..... | 750 | 15 | | | | |
| Clams: | | | | | | |
| Hard— | | | | | | |
| Public..... | 293,520 | 99,348 | 195,360 | 63,600 | 79,120 | 27,300 |
| Private..... | 22,640 | 12,425 | | | | |
| Soft— | | | | | | |
| Public..... | 136,000 | 13,189 | 6,000 | 900 | 5,000 | 875 |
| Private..... | 125,000 | 10,750 | | | | |
| Razor..... | 23,390 | 3,500 | | | | |
| Oysters: | | | | | | |
| Market— | | | | | | |
| Public..... | 875 | 150 | 1,120 | 400 | | |
| Private..... | 723,835 | 265,397 | 21,945 | 5,380 | | |
| Seed—Private..... | 68,978 | 5,912 | | | | |
| Scallops..... | 501,264 | 145,523 | 42,500 | 14,200 | 301,020 | 88,325 |
| Cockles..... | 2,400 | 1,025 | | | | |
| Lobsters..... | 99,420 | 26,988 | 256,618 | 54,402 | 610,497 | 104,610 |
| Shrimp..... | 3,100 | 1,550 | | | | |
| Spawn..... | 37,107 | 1,601 | | | | |
| Livers..... | 150 | 1 | | | | |
| Sperm oil..... | 678,375 | 92,450 | 867,038 | 125,661 | | |
| Ambergris..... | 30 | 5,000 | | | | |
| Alowife scale..... | 4,000 | 2,000 | | | | |
| Total..... | 49,916,193 | 2,077,114 | 2,964,672 | 360,649 | 3,869,707 | 428,770 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.

| Item. | Essex. | | Nantucket. | | Norfolk. | |
|--|------------|-----------|------------|---------|----------|---------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 2,345 | | 43 | | | |
| On vessels transporting..... | 30 | | 3 | | | |
| Inshore fisheries..... | 624 | | 100 | | 45 | |
| Shoremen..... | 2,058 | | 6 | | 2 | |
| Total..... | 5,057 | | 152 | | 47 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Steam..... | 11 | \$502,065 | 1 | \$4,000 | | |
| Tonnage..... | 931 | | 15 | | | |
| Outfit..... | | 119,866 | | 1,630 | | |
| Gasoline..... | 146 | 1,950,303 | 13 | 24,200 | | |
| Tonnage..... | 5,302 | | 122 | | | |
| Outfit..... | | 671,348 | | 16,075 | | |
| Sail..... | 23 | 379,500 | 1 | 100 | | |
| Tonnage..... | 1,780 | | 5 | | | |
| Outfit..... | | 110,222 | | 15 | | |
| Vessels transporting: | | | | | | |
| Gasoline..... | 5 | 59,350 | 1 | 300 | | |
| Tonnage..... | 290 | | 6 | | | |
| Outfit..... | | 3,170 | | | | |
| Sail..... | 3 | 13,840 | | | | |
| Tonnage..... | 132 | | | | | |
| Outfit..... | | 2,375 | | | | |
| Boats: | | | | | | |
| Sail, row, etc..... | 163 | 4,435 | 20 | 700 | 21 | \$680 |
| Power..... | 324 | 152,390 | 78 | 25,655 | 31 | 7,450 |
| Apparatus, vessel fisheries: | | | | | | |
| Pursegines..... | 64 | 130,700 | 1 | 600 | | |
| Gill nets..... | 3,089 | 63,875 | 100 | 1,600 | | |
| Otter trawls..... | 36 | 4,145 | 6 | 360 | | |
| Lines, hand and trawl..... | | 82,495 | | | | |
| Harpoons..... | | 2,780 | | 200 | | |
| Dredges..... | | | 42 | 795 | | |
| Rakes..... | | | 2 | 40 | | |
| Apparatus, shore fisheries: | | | | | | |
| Pursegines..... | 20 | 39,000 | | | | |
| Haulseines..... | 11 | 575 | | | | |
| Gill nets..... | 1,724 | 40,363 | 10 | 1,500 | | |
| Pound nets, trap nets, and weirs..... | 43 | 19,650 | 3 | 3,000 | | |
| Dip nets..... | 12 | 63 | | | | |
| Otter trawls..... | 25 | 1,440 | 32 | 835 | | |
| Lines, hand and trawl..... | | 14,797 | | 265 | | 70 |
| Spears..... | 6 | 11 | | | 8 | 20 |
| Cockle traps..... | 280 | 110 | | | | |
| Lobster pots..... | 10,850 | 24,820 | 622 | 1,866 | 2,289 | 6,440 |
| Eel pots..... | 119 | 326 | 180 | 540 | 15 | 45 |
| Dredges..... | | | 384 | 1,720 | | |
| Rakes..... | | | 40 | 1,010 | 5 | 30 |
| Forks and haws..... | 154 | 268 | | | 11 | 22 |
| Shore and accessory property..... | | 3,563,965 | | 30,165 | | 3,145 |
| Cash capital..... | | 771,795 | | 5,000 | | 1,200 |
| Total..... | | 8,337,022 | | 120,191 | | 19,102 |
| PRODUCTS. | | | | | | |
| Alsewives: | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Fresh..... | 29,815 | \$344 | 16,400 | \$164 | | |
| Salted..... | | | 27,000 | 1,080 | | |
| Bluefish..... | 668 | 71 | | | | |
| Boards..... | 670 | 54 | 59,100 | 5,470 | | |
| Butterfish..... | 20,469 | 2,126 | | | | |
| Cutfish and wallfish..... | 64,236 | 1,991 | | | | |
| Cod: | | | | | | |
| Fresh..... | 39,449,727 | 1,695,709 | 192,400 | 8,120 | 22,000 | \$1,760 |
| Salted..... | 3,137,905 | 162,452 | 30,000 | 3,600 | | |
| Connet..... | 2,809 | 85 | | | | |
| Cook: | | | | | | |
| Fresh..... | 1,073,168 | 37,681 | | | | |
| Salted..... | 16,870 | 759 | | | | |
| Eel..... | 113,991 | 10,177 | 30,000 | 4,500 | 3,000 | 530 |
| Flounder..... | 2,171,725 | 93,785 | 611,210 | 49,090 | 8,000 | 800 |
| Haddock: | | | | | | |
| Fresh..... | 25,468,781 | 714,799 | 16,100 | 508 | 500 | 40 |
| Salted..... | 373,574 | 16,996 | | | | |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.

| Item. | Essex. | | Nantucket. | | Norfolk. | |
|----------------------|-------------|-----------|------------|---------|----------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| PRODUCTS—continued. | | | | | | |
| Hake: | | | | | | |
| Fresh..... | 1,957,170 | \$79,601 | | | | |
| Salted..... | 29,095 | 1,307 | | | | |
| Halibut: | | | | | | |
| Fresh..... | 1,435,835 | 249,254 | | | | |
| Salted..... | 8,045 | 1,060 | | | | |
| Herring..... | 2,241,108 | 29,625 | 2,000 | \$300 | | |
| Mackerel: | | | | | | |
| Fresh..... | 6,953,882 | 661,856 | 89,700 | 7,925 | | |
| Salted..... | 1,249,082 | 109,948 | | | | |
| Perch, yellow..... | 500 | 25 | | | | |
| Pollock: | | | | | | |
| Fresh..... | 13,956,759 | 341,242 | 28,400 | 1,486 | 1,000 | \$0.80 |
| Salted..... | 50,153 | 1,774 | | | | |
| Rosefish..... | 20,150 | 487 | | | | |
| Scup..... | | | 2,450 | 245 | | |
| Sea bass..... | 18 | 2 | 2,000 | 300 | | |
| Shad..... | 33,366 | 1,297 | 12,800 | 750 | | |
| Sharks..... | 9,594 | 319 | | | | |
| Skates and rays..... | 3,510 | 56 | | | | |
| Smelt..... | 7,796 | 1,864 | | | 22,200 | 6,425 |
| Sturgeon..... | 1,080 | 103 | 4,500 | 1,800 | | |
| Sturgeon caviar..... | | | 120 | 271 | | |
| Sturgeon roe..... | 6 | 13 | | | | |
| Swordfish..... | 275,502 | 64,951 | 1,300 | 214 | | |
| Tautog..... | 158 | 6 | | | 2,000 | 180 |
| Tilefish..... | 116,670 | 7,000 | | | | |
| Tuna..... | 5,000 | 750 | | | | |
| Whiting..... | 2,564,231 | 11,343 | 53,600 | 660 | | |
| Squid..... | 121,831 | 1,671 | 3,350 | 83 | | |
| Clams: | | | | | | |
| Hard, public..... | 600 | 75 | 247,944 | 68,836 | | |
| Soft, public..... | 460,060 | 58,206 | | | 63,470 | 9,620 |
| Seallops..... | | | 103,452 | 46,230 | | |
| Cockles..... | 300,000 | 1,350 | | | | |
| Crabs, hard..... | 18,167 | 395 | | | 18,475 | 554 |
| Lobsters..... | 677,387 | 161,249 | 19,446 | 8,759 | 77,054 | 19,390 |
| Shrimp..... | 300 | 39 | | | | |
| Tongues..... | 600 | 12 | | | | |
| Spawn..... | 57,462 | 3,401 | | | | |
| Livers..... | 282,875 | 4,366 | | | | |
| Irish moss..... | | | | | 25,500 | 1,912 |
| Total..... | 104,762,381 | 4,531,677 | 1,553,572 | 210,391 | 243,199 | 41,291 |

| Item. | Plymouth. | | Suffolk. | | Total. | |
|------------------------------|-----------|---------|----------|-------------|---------|-------------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| PERSONS ENGAGED. | | | | | | |
| On vessels fishing..... | 2 | | 1,293 | | 4,459 | |
| On vessels transporting..... | 1 | | 27 | | 66 | |
| Inshore fisheries..... | 485 | | 513 | | 3,737 | |
| Shoresmen..... | 99 | | 1,078 | | 4,084 | |
| Total..... | 586 | | 2,911 | | 12,346 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Steam..... | | | 21 | \$1,966,480 | 34 | \$2,484,545 |
| Tonnage..... | | | 2,309 | | 3,310 | |
| Outfit..... | | | | 304,045 | | 429,961 |
| Gasoline..... | 1 | \$2,500 | 51 | 501,755 | 308 | 2,776,508 |
| Tonnage..... | 8 | | 1,856 | | 8,202 | |
| Outfit..... | | 120 | | 241,845 | | 1,059,438 |
| Sail..... | | | 12 | 191,015 | 54 | 808,315 |
| Tonnage..... | | | 861 | | 4,734 | |
| Outfit..... | | | | 91,350 | | 352,312 |
| Vessels transporting: | | | | | | |
| Gasoline..... | | | 13 | 40,800 | 22 | 108,950 |
| Tonnage..... | | | 147 | | 460 | |
| Outfit..... | | | | 13,060 | | 16,680 |
| Sail..... | | | | | 3 | 13,800 |
| Tonnage..... | | | | | 132 | |
| Outfit..... | | | | | | 2,375 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.

| Item. | Plymouth. | | Suffolk. | | Total. | |
|-----------------------------------|-----------|---------|------------|-----------|------------|------------|
| INVESTMENT—continued. | | | | | | |
| Boats: | Number. | Value. | Number. | Value. | Number. | Value. |
| Sail, row, etc. | 219 | \$5,655 | 33 | \$1,830 | 1,308 | \$58,488 |
| Power. | 280 | 90,570 | 191 | 258,860 | 1,732 | 891,195 |
| Apparatus, vessel fisheries: | | | | | | |
| Purse seines. | | | 9 | 24,000 | 100 | 193,850 |
| Gill nets. | | | 685 | 12,745 | 5,430 | 107,485 |
| Other trawls. | | | 33 | 10,100 | 119 | 17,850 |
| Lines, hand and trawl. | | | | 39,215 | | 133,650 |
| Harpoons. | | | | 1,225 | | 6,650 |
| Lobster pots. | | | | | 430 | 1,050 |
| Dredges. | 10 | 60 | | | 224 | 2,516 |
| Tongs. | | | | | 1 | 9 |
| Rakes. | | | | | 2 | 40 |
| Whaling apparatus. | | | | | | 29,000 |
| Apparatus, shore fisheries: | | | | | | |
| Purse seines. | 1 | 300 | | | 26 | 42,050 |
| Haul seines. | 2 | 180 | 6 | 1,200 | 41 | 3,995 |
| Gill nets. | 38 | 1,675 | 975 | 19,500 | 3,688 | 77,323 |
| Pound nets, trap nets, and weirs. | 8 | 7,820 | | | 254 | 387,470 |
| Fyke nets. | | | | | 53 | 1,585 |
| Row nets. | | | | | 13 | 36 |
| Dip nets. | 22 | 132 | 7 | 41 | 104 | 374 |
| Other trawls. | 2 | 120 | 42 | 2,100 | 191 | 9,510 |
| Lines, hand and trawl. | | 719 | | 25,068 | | 51,412 |
| Harpoons. | | | | | | 540 |
| Spears. | 2 | 6 | | | 72 | 171 |
| Cunner traps. | | | | | 4 | 6 |
| Cockle traps. | | | | | 680 | 500 |
| Lobster pots. | 11,347 | 31,182 | 2,250 | 5,970 | 43,012 | 109,359 |
| Eel pots. | 132 | 306 | | | 1,826 | 4,455 |
| Dredges. | 622 | 3,880 | | | 2,764 | 16,521 |
| Tongs. | 50 | 201 | | | 235 | 1,305 |
| Rakes. | 56 | 263 | | | 784 | 5,656 |
| Forks and hoes. | 130 | 265 | 53 | 91 | 475 | 887 |
| Shore and accessory property. | | 106,136 | | 1,614,181 | | 7,000,239 |
| Cash capital. | | 7,300 | | 1,408,000 | | 1,902,045 |
| Total. | | 259,570 | | 6,774,476 | | 19,111,269 |
| PRODUCTS. | | | | | | |
| Alewives: | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Fresh. | 81,050 | \$704 | 800 | \$8 | 1,097,476 | \$23,070 |
| Salted. | 230,000 | 9,775 | | | 1,289,134 | 55,995 |
| Smoked. | | | | | 39,000 | 2,845 |
| Bluefish. | | | | | 4,721 | 791 |
| Bonito. | | | 200 | 12 | 189,727 | 18,018 |
| Butterfish. | 4,775 | 517 | 22,485 | 1,887 | 296,828 | 26,810 |
| Cutfish and wolfish. | | | 205,976 | 6,898 | 291,188 | 9,219 |
| Cod: | | | | | | |
| Fresh. | 182,113 | 7,926 | 19,964,179 | 858,359 | 66,320,920 | 2,826,091 |
| Salted. | 1,000 | 200 | | | 3,175,405 | 166,792 |
| Cunners. | | | | | 9,959 | 585 |
| Cusk: | | | | | | |
| Fresh. | 3,000 | 84 | 468,741 | 16,807 | 1,561,337 | 55,068 |
| Salted. | | | | | 16,870 | 759 |
| Eels. | 9,700 | 1,203 | 490 | 7 | 374,167 | 47,714 |
| Flounders. | 42,700 | 1,994 | 2,348,824 | 102,883 | 10,262,693 | 478,550 |
| Gracfish. | | | | | 63,667 | 184 |
| Goosefish. | | | | | 2,560 | 7 |
| Haddock: | | | | | | |
| Fresh. | 4,750 | 183 | 46,383,268 | 1,298,776 | 77,804,810 | 2,191,215 |
| Salted. | | | | | 373,574 | 16,996 |
| Hake: | | | | | | |
| Fresh. | 3,100 | 125 | 1,443,416 | 59,107 | 4,066,437 | 156,352 |
| Salted. | | | | | 29,095 | 1,307 |
| Hallibut: | | | | | | |
| Fresh. | | | | | 233,356 | 37,593 |
| Salted. | | | | | 1,708,569 | 296,232 |
| Herring. | 1,810,690 | 11,519 | 223,476 | 6,304 | 8,045 | 1,060 |
| Rock bass. | | | | | 10,811,409 | 129,408 |
| Knottfish. | | | | | 12,800 | 830 |
| Launce. | | | | | 72 | 18 |
| Mackerel: | | | | | 67,890 | 838 |
| Fresh. | 48,887 | 5,991 | 979,030 | 131,064 | 12,267,132 | 1,212,461 |
| Salted. | | | | | 1,249,062 | 109,048 |
| Prigate. | | | | | 61,361 | 1,862 |
| Menhaden. | 40,000 | 300 | | | 161,219 | 2,231 |
| Milnows. | | | | | 1,000 | 125 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS
IN 1919, BY COUNTIES—Continued.

| Item. | Plymouth. | | Suffolk. | | Total. | |
|----------------------|-----------|---------|------------|-----------|--------------|------------|
| PRODUCTS—continued. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Perch: | | | | | | |
| White..... | | | | | 6,200 | \$920 |
| Yellow..... | | | | | 500 | 25 |
| Pollock: | | | | | | |
| Fresh..... | 15,600 | \$474 | 3,904,711 | \$93,735 | 19,192,388 | 468,169 |
| Salted..... | | | | | 50,153 | 1,774 |
| Pompano..... | | | | | 14 | 2 |
| Rockfish..... | | | 16,318 | 628 | 36,773 | 1,124 |
| Round herring..... | | | | | 911 | 19 |
| Sculpin..... | | | | | 6,000 | 15 |
| Scup..... | 500 | 30 | | | 78,624 | 5,666 |
| Sea bass..... | 50 | 5 | | | 15,067 | 1,649 |
| Sea robin..... | | | | | 400 | 1 |
| Shad..... | | | 10,137 | 617 | 62,337 | 4,309 |
| Sharks..... | | | 1,105 | 54 | 328,399 | 3,664 |
| Skates and rays..... | | | 2,310 | 49 | 100,354 | 593 |
| Smolt..... | 7,500 | 2,025 | 1,300 | 325 | 39,150 | 10,690 |
| Squeteague..... | | | | | 5,777 | 908 |
| Striped bass..... | | | | | 971 | 231 |
| Sturgeon..... | | | 1,335 | 264 | 12,098 | 3,358 |
| Sturgeon caviar..... | | | | | 150 | 356 |
| Sturgeon roe..... | | | | | 181 | 163 |
| Swordfish..... | | | 91,313 | 20,700 | 711,729 | 155,330 |
| Tautog..... | 7,100 | 640 | | | 91,876 | 8,888 |
| Tiefish..... | | | 33,510 | 1,473 | 188,180 | 9,803 |
| Tomcod..... | | | 1,000 | 50 | 7,890 | 239 |
| Tuna..... | 800 | 80 | | | 42,901 | 3,548 |
| Whiting..... | 7,000 | 53 | | | 13,918,650 | 148,854 |
| Other species..... | | | | | 38,232 | 2,117 |
| Squid..... | 13,800 | 309 | | | 6,134,557 | 108,861 |
| Blackfish..... | | | | | 40,000 | 40 |
| Porpoise..... | | | | | 750 | 15 |
| Clams: | | | | | | |
| Hard— | | | | | | |
| Public..... | 36,700 | 12,183 | | | 1,853,304 | 271,342 |
| Private..... | | | | | 2,22,640 | 12,425 |
| Soft— | | | | | | |
| Public..... | 1,146,100 | 122,885 | 246,000 | 26,519 | 32,062,630 | 232,194 |
| Private..... | | | | | 4,125,000 | 10,750 |
| Razor..... | | | | | 5,23,300 | 3,500 |
| Oysters: | | | | | | |
| Market— | | | | | | |
| Public..... | 3,584 | 833 | | | 6,5,579 | 1,383 |
| Private..... | 23,275 | 7,387 | | | 7,769,055 | 278,164 |
| Seed— | | | | | | |
| Public..... | 23,100 | 1,320 | | | 8,23,100 | 1,320 |
| Private..... | 11,200 | 640 | | | 9,80,178 | 6,552 |
| Scallops..... | 381,450 | 145,104 | | | 10,1,332,486 | 439,382 |
| Cockles..... | 275,000 | 1,050 | | | 11,577,400 | 3,425 |
| Crabs: | | | | | | |
| Hard..... | 8,000 | 165 | 1,720,319 | 48,310 | 12,1,704,961 | 49,424 |
| Soft..... | 266 | 40 | | | 13,266 | 40 |
| Lobsters..... | 575,829 | 119,589 | 71,385 | 21,415 | 2,387,636 | 516,333 |
| Shrimp..... | | | | | 3,400 | 1,589 |
| Tongue..... | | | | | 600 | 12 |
| Spawn..... | | | 52,360 | 3,834 | 146,929 | 8,836 |
| Livers..... | | | 30,550 | 477 | 313,575 | 4,844 |
| Sperm oil..... | | | | | 14,1,545,413 | 218,111 |
| Ambergris..... | | | | | 30 | 5,000 |
| Alewiffe scales..... | 6,400 | 3,200 | | | 10,400 | 5,200 |
| Irish moss..... | 178,700 | 13,115 | | | 204,200 | 15,027 |
| Total..... | 5,186,689 | 471,639 | 78,454,828 | 2,738,215 | 246,951,241 | 10,859,746 |

¹ 106,663 bushels.² 2,830 bushels.³ 206,263 bushels.⁴ 12,500 bushels.⁵ 2,330 bushels.⁶ 797 bushels.⁷ 109,865 bushels.⁸ 3,300 bushels.⁹ 11,454 bushels.¹⁰ 222,081 bushels.¹¹ 57,740 bushels.¹² 5,294,883 in number.¹³ 798 in number.¹⁴ 206,055 gallons.

FISHERIES BY APPARATUS.

The combined yield of all forms of apparatus employed in both the vessel and shore fisheries of Massachusetts in 1919 amounted to 246,951,241 pounds, valued at \$10,859,746. Lines were the most

productive form, yielding 108,703.430 pounds, valued at \$4,311,755, the principal species taken being: Cod, 62,604.055 pounds, valued at \$2,699,786; haddock, 33,154.060 pounds, valued at \$945,599; halibut, 1,649.305 pounds, valued at \$285,860; hake, 3,436.229 pounds, valued at \$130,755; and pollock, 4,698,115 pounds, valued at \$116,328. Otter trawls ranked second, with 58,584,932 pounds, valued at \$1,906,360, of which 42,593,223 pounds, valued at \$1,195,092, were haddock. Gill nets, employed chiefly in the taking of mackerel, pollock, haddock, and cod, yielded 18,204,216 pounds, valued at \$814,940. The catch with seines amounted to 14,159,335 pounds, valued at \$792,721. The most important species taken in seines was mackerel, the catch of which amounted to 8,552,827 pounds, valued at \$738,220. Various species were taken in pound nets, trap nets, and weirs to the amount of 32,314,809 pounds, valued at \$655,005. Other important forms of apparatus used in both the vessel and shore fisheries were dredges, with 2,023,428 pounds of oysters, scallops, and clams, valued at \$680,331; tongs, rakes, hoes, and forks, with 3,387,906 pounds of oysters, scallops, clams, and Irish moss, valued at \$577,203; and lobster pots with 4,152,597 pounds of lobsters and crabs, valued at \$565,817.

The following tables give the products of the vessel and shore fisheries by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

| Apparatus and species. | Barnstable. | | Bristol. | | Dukes. | |
|---------------------------|-------------|---------|----------|--------|---------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Otter trawls: | | | | | | |
| Cod—Fresh..... | 1,260 | \$60 | 650 | \$25 | | |
| Flounders..... | 2,888,935 | 110,022 | 92,000 | 4,800 | 243,420 | \$12,805 |
| Haddock—Fresh..... | 220 | 13 | | | | |
| Hake..... | 385 | 5 | | | | |
| Pollock—Fresh..... | | | 120 | 4 | | |
| Scallops..... | | | 300 | 200 | | |
| Total..... | 2,890,800 | 110,100 | 93,150 | 5,031 | 243,420 | 12,805 |
| Lines: | | | | | | |
| Catfish and wolffish..... | 7,364 | 235 | | | | |
| Cod—Fresh..... | 3,012,246 | 94,045 | 174,325 | 10,575 | 155,928 | 12,592 |
| Cusk—Fresh..... | 12,295 | 382 | | | | |
| Flounders..... | 12,178 | 444 | | | | |
| Haddock—Fresh..... | 5,224,160 | 151,401 | | | 64,000 | 4,480 |
| Hake—Fresh..... | 207,258 | 7,232 | 350 | 25 | 15,000 | 1,500 |
| Halibut—Fresh..... | 9,107 | 2,681 | 20,000 | 5,000 | | |
| Pollock—Fresh..... | 229,186 | 4,895 | | | | |
| Rosefish..... | 305 | 9 | | | | |
| Tautog..... | | | 4,125 | 450 | | |
| Tilefish..... | | | 38,000 | 1,330 | | |
| Spawn..... | 37,197 | 1,691 | | | | |
| Total..... | 8,751,206 | 262,915 | 236,800 | 17,380 | 234,928 | 18,572 |
| Seines: | | | | | | |
| Butterfish..... | 248 | 29 | | | | |
| Cod..... | 12,371 | 358 | | | | |
| Cusk..... | 1,030 | 21 | | | | |
| Flounders..... | 4,668 | 164 | | | | |
| Haddock..... | 2,960 | 84 | | | | |
| Hake..... | 5,450 | 202 | | | | |
| Herring..... | 513,940 | 9,158 | | | | |
| Mackerel, fresh..... | 1,616,538 | 126,082 | 127,500 | 13,750 | 37,500 | 4,950 |
| Pollock..... | 53,470 | 1,379 | | | | |
| Smelt..... | 257 | 38 | | | | |
| Total..... | 2,210,622 | 137,714 | 127,500 | 13,750 | 37,500 | 4,950 |

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Barnstable. | | Bristol. | | Dukes. | |
|-----------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Gill nets: | | | | | | |
| Mackerel..... | 248, 748 | \$27, 397 | 92, 900 | \$7, 890 | 218, 330 | \$27, 890 |
| Total..... | 248, 748 | 27, 397 | 92, 900 | 7, 890 | 218, 330 | 27, 890 |
| Harpoons: Swordfish..... | 112, 935 | 20, 860 | 106, 741 | 22, 265 | 106, 038 | 23, 120 |
| Whaling gear: | | | | | | |
| Ambergris..... | 30 | 5, 000 | | | | |
| Sperm oil..... | 678, 375 | 92, 450 | 867, 038 | 125, 661 | | |
| Total..... | 678, 405 | 97, 450 | 867, 038 | 125, 661 | | |
| Lobster pots: Lobsters..... | 1, 200 | 400 | 2, 740 | 685 | 18, 682 | 3, 228 |
| Dredges: | | | | | | |
| Clams, hard..... | 4, 800 | 1, 200 | | | | |
| Oysters— | | | | | | |
| Market, private..... | 356, 685 | 142, 040 | 21, 000 | 5, 250 | | |
| Seed, private..... | 17, 290 | 1, 482 | | | | |
| Scallops..... | 68, 610 | 22, 375 | | | 2, 400 | 1, 000 |
| Total..... | 447, 385 | 167, 097 | 21, 000 | 5, 250 | 2, 400 | 1, 000 |
| Tongs and rakes: Clams, hard..... | | | 2, 800 | 1, 050 | | |
| Grand total..... | 15, 341, 301 | \$23, 933 | 1, 550, 669 | 198, 962 | 861, 298 | 91, 565 |

| Apparatus and species. | Essex. | | Nantucket. | | Plymouth. | |
|---------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Otter trawls: | | | | | | |
| Butterfish..... | 330 | \$23 | | | | |
| Catfish and wolffish..... | 4, 616 | 312 | | | | |
| Cod— | | | | | | |
| Fresh..... | 2, 494, 530 | 107, 285 | 41, 000 | \$2, 050 | | |
| Salted..... | 40, 000 | 2, 200 | | | | |
| Cusk— | | | | | | |
| Fresh..... | 24, 765 | 892 | | | | |
| Salted..... | 15, 000 | 675 | | | | |
| Flounders..... | 1, 179, 280 | 47, 147 | 336, 000 | 26, 880 | | |
| Haddock— | | | | | | |
| Fresh..... | 8, 326, 644 | 234, 134 | 1, 000 | 50 | | |
| Salted..... | 194, 000 | 6, 790 | | | | |
| Hake..... | 32, 658 | 1, 338 | | | | |
| Halibut..... | 13, 622 | 2, 316 | | | | |
| Hallock— | | | | | | |
| Fresh..... | 443, 280 | 10, 638 | | | | |
| Salted..... | 14, 045 | 456 | | | | |
| Rosefish..... | 9, 140 | 229 | | | | |
| Whiting..... | 445 | 4 | | | | |
| Total..... | 12, 792, 355 | 414, 439 | 378, 000 | 28, 980 | | |
| Lines: | | | | | | |
| Catfish and wolffish..... | 42, 237 | 1, 136 | | | | |
| Cod— | | | | | | |
| Fresh..... | 34, 344, 909 | 1, 479, 211 | | | | |
| Salted..... | 3, 097, 905 | 160, 252 | | | | |
| Cusk— | | | | | | |
| Fresh..... | 821, 692 | 28, 627 | | | | |
| Salted..... | 1, 870 | 84 | | | | |
| Flounders..... | 6, 016 | 213 | | | | |
| Haddock— | | | | | | |
| Fresh..... | 14, 653, 310 | 410, 530 | | | | |
| Salted..... | 179, 574 | 10, 206 | | | | |
| Hake— | | | | | | |
| Fresh..... | 1, 258, 021 | 50, 721 | | | | |
| Salted..... | 29, 095 | 1, 307 | | | | |
| Halibut— | | | | | | |
| Fresh..... | 1, 416, 132 | 245, 904 | | | | |
| Salted..... | 8, 045 | 1, 060 | | | | |
| Pollack— | | | | | | |
| Fresh..... | 1, 503, 661 | 36, 702 | | | | |
| Salted..... | 27, 258 | 883 | | | | |
| Rosefish..... | 3, 470 | 124 | | | | |
| Sharks..... | 1, 118 | 28 | | | | |
| Skates..... | 20 | 1 | | | | |

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Essex. | | Nantucket. | | Plymouth. | |
|-----------------------------------|------------|-----------|------------|--------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Lines—Continued. | | | | | | |
| Tilefish..... | 116,670 | \$7,000 | | | | |
| Livers..... | 2,225 | 38 | | | | |
| Spawn..... | 54,750 | 3,255 | | | | |
| Total..... | 57,567,978 | 2,437,372 | | | | |
| Seines: | | | | | | |
| Bonito..... | 300 | 30 | | | | |
| Butterfish..... | 40 | 4 | | | | |
| Cod..... | 5,900 | 254 | | | | |
| Haddock..... | 1,025 | 29 | | | | |
| Hake..... | 3,318 | 136 | | | | |
| Herring..... | 556,112 | 6,105 | | | | |
| Mackerel— | | | | | | |
| Fresh..... | 4,788,267 | 400,778 | 2,000 | \$200 | | |
| Salted..... | 1,249,062 | 109,948 | | | | |
| Pollock..... | 2,095,253 | 46,863 | | | | |
| Shad..... | 822 | 138 | | | | |
| Sharks..... | 180 | 11 | | | | |
| Spawn..... | 1,100 | 58 | | | | |
| Total..... | 8,701,379 | 564,354 | 2,000 | 200 | | |
| Gill nets: | | | | | | |
| Bonito..... | 280 | 15 | | | | |
| Butterfish..... | 1,060 | 58 | | | | |
| Cod..... | 1,241,606 | 50,195 | | | | |
| Haddock..... | 2,019,379 | 55,729 | | | | |
| Hake..... | 194,641 | 7,988 | | | | |
| Mackerel..... | 1,391,665 | 181,983 | 24,000 | 2,400 | | |
| Pollock..... | 9,217,089 | 229,255 | | | | |
| Rossetfish..... | 825 | 35 | | | | |
| Shad..... | 7,800 | 153 | | | | |
| Sharks..... | 100 | 1 | | | | |
| Skates..... | 30 | 1 | | | | |
| Shrimp..... | 300 | 39 | | | | |
| Livers..... | 195,650 | 3,053 | | | | |
| Spawn..... | 30 | 1 | | | | |
| Total..... | 14,270,455 | 528,504 | 24,000 | 2,400 | | |
| Harpoons: Swordfish..... | 275,502 | 64,951 | 1,300 | 214 | | |
| Dredges: | | | | | | |
| Clams, hard..... | | | 132,000 | 39,050 | | |
| Scallops..... | | | 8,700 | 3,500 | 4,680 | \$1,320 |
| Total..... | | | 140,700 | 42,550 | 4,680 | 1,320 |
| Tongs and rakes: Clams, hard..... | | | 4,800 | 1,800 | | |
| Grand total..... | 93,607,669 | 4,009,620 | 550,800 | 76,144 | 4,680 | 1,320 |

| Apparatus and species. | Suffolk. | | Total. | |
|--------------------------|------------|---------|------------|-----------|
| | Pounds. | Value. | Pounds. | Value. |
| Otter trawls: | | | | |
| Butterfish..... | 21,519 | \$1,782 | 21,679 | \$1,805 |
| Catfish and wolfish..... | 62,671 | 1,647 | 67,287 | 1,959 |
| Cod— | | | | |
| Fresh..... | 2,453,117 | 105,491 | 4,990,557 | 214,911 |
| Salted..... | | | 40,000 | 2,200 |
| Cusk— | | | | |
| Fresh..... | 6,550 | 236 | 31,315 | 1,128 |
| Salted..... | | | 15,000 | 675 |
| Eels..... | 490 | 7 | 490 | 7 |
| Flounders..... | 1,062,262 | 47,269 | 5,801,897 | 248,923 |
| Haddock— | | | | |
| Fresh..... | 34,057,878 | 953,728 | 42,385,742 | 1,187,925 |
| Salted..... | | | 194,000 | 6,790 |
| Hake..... | 397,579 | 16,298 | 430,702 | 17,643 |
| Haitaut..... | 54,627 | 9,116 | 67,249 | 11,432 |
| Pollock— | | | | |
| Fresh..... | 311,442 | 7,475 | 754,842 | 18,117 |
| Salted..... | | | 14,045 | 456 |
| Rossetfish..... | 2,405 | 90 | 11,545 | 319 |
| Shad..... | 7 | 1 | 7 | 1 |
| Sharks..... | 990 | 52 | 990 | 52 |

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Suffolk. | | Total. | |
|--------------------------|------------|-----------|------------|-----------|
| | Pounds. | Value. | Pounds. | Value. |
| Otter trawls—Continued. | | | | |
| Skates..... | 1,810 | \$39 | 1,810 | \$9 |
| Sturgeon..... | 1,335 | 264 | 1,335 | 264 |
| Whiting..... | | | 445 | 4 |
| Sealops..... | | | 300 | 200 |
| Total..... | 38,433,712 | 1,143,495 | 54,831,437 | 1,714,850 |
| Lines: | | | | |
| Catfish and wolfish..... | 15,509 | 454 | 65,110 | 1,825 |
| Cod— | | | | |
| Fresh..... | 15,189,656 | 653,053 | 52,877,064 | 2,249,476 |
| Salted..... | | | 3,097,905 | 160,252 |
| Cusk— | | | | |
| Fresh..... | 358,353 | 12,890 | 1,192,340 | 41,899 |
| Salted..... | | | 1,870 | 84 |
| Flounders..... | 15,909 | 646 | 34,103 | 1,293 |
| Haddock— | | | | |
| Fresh..... | 10,467,834 | 293,006 | 30,409,304 | 859,417 |
| Salted..... | | | 179,574 | 10,206 |
| Hake— | | | | |
| Fresh..... | 884,876 | 36,202 | 2,365,505 | 95,680 |
| Salted..... | | | 29,095 | 1,307 |
| Halibut— | | | | |
| Fresh..... | 178,280 | 28,231 | 1,623,519 | 281,816 |
| Salted..... | | | 8,045 | 1,060 |
| Pollock— | | | | |
| Fresh..... | 1,556,431 | 37,447 | 3,289,278 | 79,134 |
| Salted..... | | | 27,258 | 883 |
| Rosefish..... | 11,078 | 430 | 14,853 | 563 |
| Sharks..... | 115 | 2 | 1,233 | 30 |
| Skates..... | | | 20 | 1 |
| Tautog..... | | | 4,125 | 450 |
| Tilefish..... | 33,510 | 1,473 | 188,180 | 9,803 |
| Livers..... | 2,250 | 51 | 4,475 | 89 |
| Spawn..... | 39,396 | 2,890 | 131,253 | 7,746 |
| Total..... | 28,753,197 | 1,066,775 | 95,544,109 | 3,803,014 |
| Seines: | | | | |
| Alewives..... | 800 | 8 | 800 | 8 |
| Bonito..... | 200 | 12 | 500 | 42 |
| Butterfish..... | 905 | 101 | 1,193 | 134 |
| Cod..... | 2,654 | 115 | 20,925 | 727 |
| Cusk..... | | | 1,030 | 21 |
| Flounders..... | | | 4,668 | 164 |
| Haddock..... | | | 4,015 | 112 |
| Hake..... | 670 | 27 | 9,438 | 365 |
| Herring..... | | | 1,069,712 | 15,263 |
| Mackerel— | | | | |
| Fresh..... | 380,214 | 44,464 | 6,952,019 | 590,224 |
| Salted..... | | | 1,249,062 | 109,948 |
| Pollock..... | 644,845 | 15,476 | 2,793,568 | 63,918 |
| Shad..... | 10,000 | 600 | 10,822 | 738 |
| Sharks..... | | | 180 | 11 |
| Smelt..... | | | 257 | 38 |
| Spawn..... | | | 1,100 | 58 |
| Total..... | 1,040,288 | 60,803 | 12,119,289 | 781,771 |
| Gill nets: | | | | |
| Bonito..... | | | 280 | 15 |
| Butterfish..... | | | 1,060 | 58 |
| Cod..... | 129,075 | 5,550 | 1,370,681 | 55,745 |
| Haddock..... | 384,286 | 10,760 | 2,403,665 | 66,489 |
| Hake..... | 15,090 | 619 | 209,731 | 8,607 |
| Mackerel..... | 273,092 | 32,296 | 2,248,735 | 279,856 |
| Pollock..... | 1,310,981 | 31,464 | 10,528,070 | 260,719 |
| Rosefish..... | | | 825 | 33 |
| Shad..... | | | 7,800 | 153 |
| Sharks..... | | | 100 | 1 |
| Skates..... | | | 30 | 1 |
| Shrimp..... | | | 300 | 39 |
| Livers..... | 28,300 | 426 | 223,950 | 3,479 |
| Spawn..... | | | 30 | 1 |
| Total..... | 2,140,824 | 81,115 | 16,995,257 | 675,196 |
| Harpoons: Swordfish..... | 91,313 | 20,700 | 693,829 | 152,110 |

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Suffolk. | | Total. | |
|-----------------------------------|------------|-------------|-------------|-----------|
| | Pounds. | Value. | Pounds. | Value. |
| Whaling gear: | | | | |
| Ambergris..... | | | 30 | \$5,000 |
| Sperm oil..... | | | 1,545,413 | 218,111 |
| Total..... | | | 1,545,443 | 223,111 |
| Lobster pots: Lobsters..... | | | 22,622 | 4,313 |
| Dredges: | | | | |
| Clams, hard..... | | | 136,800 | 40,250 |
| Oysters— | | | | |
| Market, private..... | | | 377,685 | 147,290 |
| Seed, private..... | | | 17,290 | 1,482 |
| Scallops..... | | | 84,390 | 28,195 |
| Total..... | | | 616,165 | 217,217 |
| Tongs and rakes: Clams, hard..... | | | 7,600 | 2,850 |
| Grand total..... | 70,459,334 | \$2,372,888 | 182,375,751 | 7,574,432 |

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS DIP NETS, AND SEINES.

| Apparatus and species. | Barnstable. | | Bristol. | | Dukes. | | Essex. | |
|-----------------------------------|-------------|---------|----------|---------|---------|---------|-----------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Pound nets, trap nets, and weirs: | | | | | | | | |
| Alewives— | | | | | | | | |
| Fresh..... | 194,566 | \$3,484 | 77,795 | \$1,540 | 96,050 | \$1,706 | 17,315 | \$244 |
| Salted..... | 35,000 | 1,750 | | | 140,000 | 6,300 | | |
| Bluefish..... | 3,932 | 696 | | | 121 | 24 | 668 | 71 |
| Bonito..... | 33,936 | 2,549 | 40 | 4 | 95,461 | 9,929 | 90 | 9 |
| Butterfish..... | 176,661 | 14,966 | 11,700 | 850 | 56,899 | 5,853 | 19,039 | 2,041 |
| Cattish and wolfish..... | | | | | | | 14 | 1 |
| Cod..... | 113,668 | 4,822 | 795 | 37 | 81 | 6 | 173,006 | 5,400 |
| Cunners..... | | | | | | | 2,809 | 85 |
| Eels..... | 3,850 | 455 | 4,500 | 450 | | | | |
| Flounders..... | 161,086 | 7,828 | 19,753 | 1,017 | 13,043 | 1,162 | 1,895 | 58 |
| Frigate mackerel..... | | | | | 61,361 | 1,862 | | |
| Grayfish..... | 1,000 | 10 | 62,667 | 174 | | | | |
| Goosefish..... | | | 2,500 | 7 | | | | |
| Haddock..... | 2,631 | 13 | | | 554 | 33 | 2,236 | 63 |
| Hake..... | 395 | 4 | 183 | 3 | 86 | 1 | 4,810 | 110 |
| Herring..... | 5,931,481 | 71,121 | 88,765 | 1,373 | 25 | 3 | 1,321,184 | 17,285 |
| Hickory shad..... | 11,650 | 780 | 1,150 | 50 | | | | |
| Kingfish..... | | | 72 | 18 | | | | |
| Launce..... | 3,800 | 38 | | | | | | |
| Mackerel..... | 1,419,313 | 148,182 | 28,605 | 2,871 | 55,007 | 5,035 | 122,886 | 13,034 |
| Menhaden..... | 69,363 | 1,605 | 46,516 | 272 | 5,400 | 54 | | |
| Perch, white..... | | | | | 6,000 | 900 | | |
| Pollock..... | 103,725 | 3,135 | 20 | 1 | 2,371 | 113 | 185,792 | 3,243 |
| Pompano..... | 14 | 2 | | | | | | |
| Round herring..... | 941 | 19 | | | | | | |
| Sculpin..... | | | 6,000 | 15 | | | | |
| Scup..... | 8,634 | 494 | 52 | 6 | 63,578 | 4,393 | | |
| Sea bass..... | | | 2,289 | 50 | 3,865 | 532 | 18 | 2 |
| Sea robin..... | | | 400 | 1 | | | | |
| Shad..... | 5,645 | 1,553 | 54 | 17 | 37 | 7 | 435 | 47 |
| Sharks..... | 11,300 | 183 | 3,175 | 71 | | | 3,000 | 75 |
| Skates and ray..... | | | 96,649 | 381 | | | | |
| Smelt..... | | | 97 | 13 | | | | |
| Squeteague..... | 613 | 74 | 932 | 151 | 4,202 | 683 | | |
| Striped bass..... | 287 | 110 | 605 | 103 | 59 | 13 | | |
| Sturgeon..... | 5,183 | 1,191 | | | | | 180 | 22 |
| Sturgeon caviar..... | 30 | 55 | | | | | | |
| Sturgeon roe..... | 175 | 150 | | | | | 6 | 13 |
| Tautog..... | 23,627 | 1,362 | 13,519 | 1,316 | 222 | 19 | 158 | 6 |
| Tomcod..... | 2,200 | 6 | 2,390 | 93 | | | | |
| Tuna..... | 37,048 | 2,716 | 53 | 2 | | | 5,000 | 750 |
| Whiting..... | 11,173,383 | 135,485 | 57,709 | 918 | 62,727 | 365 | 2,563,786 | 11,339 |

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS, DIP NETS, AND SEINES—Continued.

| Apparatus and species. | Barnstable. | | Bristol. | | Dukes. | | Essex. | |
|---|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Pound nets, trap nets, and weirs—Continued. | 9,500 | \$100 | 8,411 | \$388 | 20,321 | \$1,629 | | |
| Other species..... | 5,837,988 | 104,364 | 141,129 | 2,184 | 16,459 | 253 | 121,831 | \$1,671 |
| Squid..... | 750 | 15 | | | | | | |
| Porpoise..... | | | | | | | | |
| Total..... | 25,382,735 | 509,347 | 675,555 | 14,406 | 703,929 | 40,875 | 4,546,068 | 55,569 |
| Dredges: | | | | | | | | |
| Clams, hard..... | 4,800 | 1,800 | | | | | | |
| Oysters, market, private.. | 138,915 | 52,237 | | | | | | |
| Scallops..... | 397,655 | 114,328 | 42,000 | 14,000 | 298,620 | 87,325 | | |
| Total..... | 541,371 | 168,365 | 42,000 | 14,000 | 298,620 | 87,325 | | |
| Otter trawls: | | | | | | | | |
| Cod..... | | | | | | | 450 | 19 |
| Flounders..... | 891,315 | 41,712 | 69,000 | 2,800 | 639,275 | 44,490 | 713,567 | 30,798 |
| Rosefish..... | | | | | | | 6,715 | 101 |
| Scup..... | | | | | 1,000 | 180 | | |
| Sea bass..... | | | | | 6,000 | 600 | | |
| Total..... | 891,315 | 41,712 | 69,000 | 2,800 | 646,275 | 45,270 | 720,732 | 30,918 |
| Gill nets: | | | | | | | | |
| Butterfish..... | 247 | 44 | | | | | | |
| Cod..... | | | | | | | 149,788 | 7,702 |
| Flounders..... | | | | | | | 4,500 | 135 |
| Haddock..... | | | | | | | 18,000 | 810 |
| Herring..... | | | | | | | 7,200 | 205 |
| Mackerel..... | 266,926 | 30,304 | 10,500 | 1,500 | 13,500 | 2,125 | 362,428 | 35,506 |
| Pollock..... | | | | | | | 1,800 | 54 |
| Sharks..... | | | | | | | 5,196 | 204 |
| Skates..... | | | | | | | 2,000 | 10 |
| Sturgeon..... | | | | | | | 900 | 81 |
| Total..... | 267,173 | 30,348 | 10,500 | 1,500 | 13,500 | 2,125 | 551,812 | 44,707 |
| Dip nets: | | | | | | | | |
| Alewives— | | | | | | | | |
| Fresh..... | 14,400 | 396 | | | | | | |
| Salted..... | 240,000 | 8,400 | | | | | | |
| Flounders..... | | | | | | | 500 | 25 |
| Herring..... | | | | | | | 152,950 | 4,268 |
| Perch, yellow..... | | | | | | | 500 | 25 |
| Scallops..... | 34,950 | 8,800 | | | | | | |
| Total..... | 289,350 | 17,596 | | | | | 153,950 | 4,318 |
| Seines: | | | | | | | | |
| Alewives— | | | | | | | | |
| Fresh..... | 63,000 | 1,279 | 27,000 | 535 | 455,100 | 12,435 | 12,500 | 100 |
| Salted..... | 364,600 | 19,190 | 60,534 | 2,220 | | | | |
| Smoked..... | 2,000 | 150 | | | | | | |
| Butterfish..... | 700 | 105 | | | | | | |
| Cod..... | 3,000 | 120 | | | | | | |
| Fls..... | | | | | 21,000 | 1,200 | 71,270 | 1,981 |
| Herring..... | 360 | 5 | | | | | 203,662 | 1,762 |
| Launce..... | 64,000 | 800 | | | | | | |
| Mackerel..... | 43,100 | 5,617 | 235 | 40 | 10,000 | 1,200 | 288,211 | 30,503 |
| Minnows..... | 1,000 | 125 | | | | | | |
| Pollock..... | | | | | | | 150,036 | 3,817 |
| Shad..... | | | 298 | 68 | | | 24,309 | 959 |
| Shrimp..... | 3,100 | 1,550 | | | | | | |
| Alewife scales..... | 3,000 | 1,500 | | | | | | |
| Total..... | 547,860 | 30,441 | 88,067 | 2,863 | 486,100 | 14,835 | 758,988 | 39,122 |

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS, DIP NETS, AND SEINES—Continued.

| Apparatus and species. | Nantucket. | | Plymouth. | | Suffolk. | | Total. | |
|-----------------------------------|------------|--------|-----------|---------|-----------|--------|------------|---------|
| Pound nets, trap nets, and weirs: | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives— | | | | \$674 | | | | |
| Fresh | 16,400 | \$164 | 80,050 | | | | 482,176 | \$7,812 |
| Salted | 27,000 | 1,080 | 230,000 | 9,775 | | | 432,000 | 18,905 |
| Bluefish | | | | | | | 4,721 | 791 |
| Bonito | 59,400 | 5,470 | | | | | 188,947 | 17,961 |
| Butterfish | | | 4,775 | 517 | | | 268,474 | 24,227 |
| Catfish and wolfish | | | | | | | 14 | 1 |
| Cod | 1,400 | 70 | | | | | 288,950 | 10,335 |
| Cunners | | | | | | | 2,809 | 85 |
| Eels | | | | | | | 8,350 | 905 |
| Flounders | 4,210 | 530 | | | | | 199,897 | 10,595 |
| Frigate mackerel | | | | | | | 61,361 | 1,862 |
| Grayfish | | | | | | | 63,667 | 184 |
| Goosefish | | | | | | | 2,500 | 7 |
| Haddock | | | | | | | 5,421 | 109 |
| Hake | | | | | | | 5,474 | 118 |
| Herring | 2,000 | 300 | 406,000 | 4,304 | | | 7,750,055 | 94,546 |
| Hickory shad | | | | | | | 12,800 | 830 |
| Kingfish | | | | | | | 72 | 18 |
| Launce | | | | | | | 3,800 | 38 |
| Mackerel | 63,700 | 5,325 | 8,687 | 803 | | | 1,698,198 | 175,250 |
| Menhaden | | | | | | | 121,219 | 1,931 |
| Perch, white | | | | | | | 900 | 900 |
| Pollock | 900 | 36 | | | | | 292,808 | 6,528 |
| Pompano | | | | | | | 14 | 2 |
| Round herring | | | | | | | 911 | 19 |
| Sculpin | | | | | | | 6,000 | 15 |
| Scup | 2,450 | 245 | | | | | 74,714 | 5,138 |
| Sea bass | 2,000 | 300 | | | | | 8,172 | 884 |
| Sea robin | | | | | | | 400 | 1 |
| Shad | 12,800 | 750 | | | | | 18,071 | 2,374 |
| Sharks | | | | | | | 17,475 | 329 |
| Skates and rays | | | | | | | 93,649 | 381 |
| Smelt | | | | | | | 97 | 13 |
| Squeteague | | | | | | | 5,777 | 908 |
| Striped bass | | | | | | | 951 | 226 |
| Sturgeon | | | | | | | 5,363 | 1,213 |
| Sturgeon caviar | | | | | | | 30 | 85 |
| Sturgeon roe | | | | | | | 181 | 163 |
| Tautog | | | | | | | 37,526 | 2,703 |
| Tomcod | | | | | | | 4,590 | 99 |
| Tuna | | | | | | | 42,101 | 3,468 |
| Whiting | 53,600 | 660 | 7,000 | 53 | | | 13,918,205 | 148,850 |
| Other species | | | | | | | 38,232 | 2,117 |
| Squid | 3,350 | 83 | 13,800 | 309 | | | 6,134,557 | 108,864 |
| Porpoise | | | | | | | 750 | 15 |
| Alewife scales | | | 6,400 | 3,200 | | | 6,400 | 3,200 |
| Total | 249,210 | 15,013 | 757,312 | 19,795 | | | 32,314,809 | 655,005 |
| Dredges: | | | | | | | | |
| Clams, hard | | | | | | | 4,800 | 1,800 |
| Oysters— | | | | | | | | |
| Market— | | | | | | | | |
| Public | | | 175 | 63 | | | 175 | 63 |
| Private | | | 16,275 | 4,887 | | | 155,190 | 57,124 |
| Seed— | | | | | | | | |
| Public | | | 23,100 | 1,320 | | | 23,100 | 1,320 |
| Private | | | 11,300 | 640 | | | 11,260 | 640 |
| Scallops | 94,752 | 42,730 | 379,770 | 143,784 | | | 1,212,798 | 402,167 |
| Total | 94,752 | 42,730 | 430,520 | 150,694 | | | 1,407,263 | 463,114 |
| Otter trawls: | | | | | | | | |
| Catfish and wolfish | | | | | 125 | \$5 | 125 | 5 |
| Cod | 20,000 | 900 | | | 7,219 | 310 | 27,669 | 1,229 |
| Flounders | 271,000 | 21,080 | 25,000 | 1,000 | 1,082,298 | 46,252 | 3,691,155 | 188,732 |
| Haddock | | | | | 13,481 | 377 | 13,481 | 377 |
| Hake | | | | | 3,958 | 172 | 3,958 | 172 |
| Pollock | | | | | 257 | 6 | 257 | 6 |
| Round herring | | | | | 2,835 | 108 | 9,550 | 209 |
| Scup | | | | | | | 1,000 | 180 |
| Sea bass | | | | | | | 6,000 | 600 |
| Total | 291,000 | 22,580 | 25,000 | 1,000 | 1,110,173 | 47,230 | 3,753,495 | 191,510 |

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS, DIP NETS, AND SEINES—Continued.

| Apparatus and species. | Nantucket. | | Plymouth. | | Suffolk. | | Total. | |
|------------------------|------------|---------|-----------|--------|----------|----------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Gill nets: | | | | | | | | |
| Butterfish..... | | | | | | | 247 | \$44 |
| Cod..... | | | 700 | \$38 | | | 150,488 | 7,740 |
| Flounders..... | | | | | | | 4,500 | 135 |
| Haddock..... | | | | | | | 18,000 | 810 |
| Herring..... | | | 4,000 | 55 | | | 11,200 | 260 |
| Mackerel..... | | | 30,000 | 4,500 | 325,724 | \$54,304 | 1,009,078 | 128,239 |
| Pollock..... | | | | | | | 1,800 | 54 |
| Shad..... | | | | | 130 | 16 | 130 | 16 |
| Sharks..... | | | | | | | 5,196 | 204 |
| Skates..... | | | | | | | 2,000 | 10 |
| Sturgeon..... | 4,500 | \$1,800 | | | | | 5,400 | 1,881 |
| Sturgeon caviar..... | 120 | 271 | | | | | 120 | 271 |
| Tuna..... | | | 800 | 80 | | | 800 | 80 |
| Total..... | 4,620 | 2,071 | 35,500 | 4,673 | 325,854 | 54,320 | 1,208,959 | 139,744 |
| Dip nets: | | | | | | | | |
| Alewives— | | | | | | | | |
| Fresh..... | | | | | | | 14,400 | 395 |
| Salted..... | | | | | | | 240,000 | 8,400 |
| Flounders..... | | | | | | | 500 | 25 |
| Herring..... | | | 1,400,000 | 7,000 | 115,670 | 3,070 | 1,668,620 | 14,338 |
| Perch, yellow..... | | | | | | | 500 | 25 |
| Crabs, soft..... | | | 266 | 40 | | | 266 | 40 |
| Scallops..... | | | | | | | 34,950 | 8,800 |
| Total..... | | | 1,400,266 | 7,040 | 115,670 | 3,070 | 1,959,236 | 32,024 |
| Seines: | | | | | | | | |
| Alewives— | | | | | | | | |
| Fresh..... | | | 1,000 | 30 | | | 558,600 | 14,379 |
| Salted..... | | | | | | | 425,134 | 21,410 |
| Smoked..... | | | | | | | 2,000 | 150 |
| Butterfish..... | | | | | 31 | 4 | 731 | 109 |
| Cod..... | | | | | | | 3,000 | 120 |
| Eels..... | | | | | | | 92,270 | 3,181 |
| Herring..... | | | | | 107,800 | 3,234 | 311,822 | 5,001 |
| Launce..... | | | | | | | 64,000 | 800 |
| Mackerel..... | | | 10,200 | 688 | | | 351,746 | 38,048 |
| Menhaden..... | | | 40,000 | 300 | | | 40,000 | 300 |
| Minnows..... | | | | | | | 1,000 | 125 |
| Pollock..... | | | | | | | 159,036 | 3,817 |
| Shad..... | | | | | | | 24,607 | 1,027 |
| Shrimp..... | | | | | | | 3,100 | 1,550 |
| Alewife scales..... | | | | | | | 3,000 | 1,500 |
| Total..... | | | 51,200 | 1,018 | 107,831 | 3,238 | 2,040,046 | 91,517 |

BY LINES, TONGS, RAKES, HOES, FORKS, EEL POTS, LOBSTER POTS, AND SPEARS.

| Apparatus and species. | Barnstable. | | Bristol. | | Dukes. | |
|--------------------------|-------------|---------|----------|--------|---------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Lines: | | | | | | |
| Butterfish..... | 3,244 | \$433 | | | | |
| Catfish and wolfish..... | 13,612 | 95 | | | | |
| Cod— | | | | | | |
| Fresh..... | 2,989,827 | 129,802 | 1,100 | \$60 | 45,250 | \$1,715 |
| Salted..... | 6,500 | 450 | | | | |
| Cusk..... | 3,103 | 33 | | | | |
| Eels..... | | | 625 | 100 | | |
| Flounders..... | 14,790 | 1,047 | 3,170 | 260 | 17,500 | 1,000 |
| Haddock..... | 635,916 | 20,846 | | | 1,000 | 40 |
| Hake..... | 431,414 | 8,396 | 2,150 | 150 | | |
| Halibut..... | 10,211 | 1,704 | | | | |
| Mackerel..... | 2,226 | 197 | 3,705 | 475 | 1,000 | 120 |
| Pollock—Fresh..... | 856,526 | 20,140 | | | 43,500 | 1,285 |
| Scup..... | 1,710 | 265 | | | 700 | 53 |
| Sea bass..... | 345 | 110 | | | 500 | 50 |
| Sharks..... | 303,225 | 3,037 | | | | |
| Skates..... | 885 | 17 | | | | |
| Striped bass..... | 20 | 5 | | | | |
| Tautog..... | 11,800 | 1,227 | 28,725 | 3,655 | 600 | 30 |
| Livers..... | 150 | 1 | | | | |
| Total..... | 5,285,504 | 187,805 | 39,475 | 4,700 | 110,050 | 4,293 |

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY LINES, TONGS, RAKES, HOES, FORKS, EEL POTS, LOBSTER POTS, AND SPEARS—Continued.

| Apparatus and species. | Barnstable. | | Bristol. | | Dukes. | |
|--------------------------------|-----------------|-----------------|-----------------|-----------------|----------------|-----------------|
| Tongs, rakes, hoes, and forks: | | | | | | |
| Clams— | | | | | | |
| Hard— | | | | | | |
| Public..... | Pounds. 281,520 | Value. \$95,523 | Pounds. 192,560 | Value. \$62,550 | Pounds. 79,120 | Value. \$27,300 |
| Private..... | 22,640 | 12,425 | | | | |
| Soft— | | | | | | |
| Public..... | 136,000 | 13,189 | 6,000 | 900 | 5,000 | 875 |
| Private..... | 125,000 | 10,750 | | | | |
| Razor..... | 23,300 | 3,500 | | | | |
| Oysters, market— | | | | | | |
| Public..... | 875 | 150 | 1,120 | 400 | | |
| Private..... | 228,235 | 71,120 | 945 | 130 | | |
| Scallops..... | 48 | 20 | | | | |
| Total..... | 817,618 | 206,677 | 200,625 | 63,980 | 84,120 | 28,175 |
| Eel pots: Eels..... | 62,443 | 7,874 | 2,253 | 180 | 18,500 | 2,305 |
| Lobster pots: Lobsters..... | 98,220 | 26,588 | 253,878 | 53,717 | 591,815 | 101,382 |
| Spears: | | | | | | |
| Eels..... | 13,235 | 2,006 | 6,800 | 1,200 | | |
| Flounders..... | 6,900 | 575 | | | | |
| Total..... | 20,135 | 2,581 | 6,800 | 1,200 | | |

| Apparatus and species. | Essex. | | Nantucket. | | Norfolk. | |
|--------------------------------|-----------|---------|------------|---------|----------|---------|
| Lines: | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Catfish and wolffish..... | 17,369 | \$542 | | | | |
| Cod— | | | | | | |
| Fresh..... | 1,039,538 | 45,643 | 130,000 | \$5,100 | 22,000 | \$1,760 |
| Salted..... | | | 30,000 | 3,600 | | |
| Cusk..... | 226,711 | 8,162 | | | | |
| Eels..... | 1,700 | 225 | | | | |
| Flounders..... | 266,058 | 15,410 | | | 8,000 | 800 |
| Haddock..... | 448,187 | 13,504 | 15,100 | 458 | 500 | 40 |
| Hake..... | 463,722 | 19,305 | | | | |
| Halibut..... | 6,081 | 1,034 | | | | |
| Mackerel..... | 425 | 52 | | | | |
| Pollock— | | | | | | |
| Fresh..... | 350,848 | 10,580 | 27,500 | 1,450 | 1,000 | 80 |
| Salted..... | 8,850 | 435 | | | | |
| Skates..... | 1,460 | 44 | | | | |
| Smolt..... | 7,796 | 1,864 | | | 22,200 | 6,425 |
| Tautog..... | | | | | 2,000 | 180 |
| Tongues..... | 600 | 12 | | | | |
| Spawn..... | 1,582 | 87 | | | | |
| Livers..... | 85,000 | 1,275 | | | | |
| Total..... | 2,926,017 | 118,177 | 202,600 | 10,608 | 55,700 | 9,285 |
| Tongs, rakes, hoes, and forks: | | | | | | |
| Clams— | | | | | | |
| Hard—Public..... | 600 | 75 | 111,144 | 27,986 | | |
| Soft—Public..... | 460,060 | 58,206 | | | 63,470 | 9,620 |
| Irish moss..... | | | | | 25,500 | 1,912 |
| Total..... | 460,660 | 58,281 | 111,144 | 27,986 | 88,970 | 11,532 |
| Eel pots: Eels..... | 32,025 | 6,190 | 30,000 | 4,500 | 1,000 | 130 |
| Lobster pots: | | | | | | |
| Lobsters..... | 677,387 | 161,249 | 19,446 | 8,759 | 77,054 | 19,390 |
| Crabs, hard..... | 18,167 | 395 | | | 18,475 | 554 |
| Total..... | 695,554 | 161,644 | 19,446 | 8,759 | 95,529 | 19,944 |
| Spears: Eels..... | 8,906 | 1,781 | | | 2,000 | 400 |

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS,
AND SPECIES—Continued.BY LINES, TONGS, RAKES, HOES, FORKS, EEL POTS, LOBSTER POTS, AND SPEARS—
Continued.

| Apparatus and species. | Plymouth. | | Suffolk. | | Total. | |
|---------------------------------------|------------------|----------------|------------------|----------------|-------------------|----------------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Lines: | | | | | | |
| Butterfish..... | | | | | 3,244 | \$433 |
| Catfish and wolffish..... | | | 127,671 | \$84,792 | 158,652 | 5,429 |
| Cod— | | | | | | |
| Fresh..... | 181,413 | \$7,888 | 2,182,458 | 93,840 | 6,591,586 | 285,808 |
| Salted..... | 1,000 | 200 | | | 37,500 | 4,250 |
| Cusk..... | 3,000 | 84 | 103,838 | 3,741 | 336,652 | 12,020 |
| Eels..... | | | | | 2,415 | 325 |
| Flounders..... | 17,700 | 994 | 188,355 | 8,716 | 515,573 | 28,227 |
| Haddock..... | 4,750 | 183 | 1,459,729 | 40,905 | 2,565,182 | 75,976 |
| Hake..... | 3,100 | 125 | 141,213 | 5,789 | 1,041,629 | 33,768 |
| Halibut..... | | | 1,449 | 246 | 17,741 | 2,984 |
| Mackerel..... | | | | | 7,356 | 844 |
| Pollock— | | | | | | |
| Fresh..... | 15,600 | 474 | 77,755 | 1,867 | 1,372,729 | 35,876 |
| Salted..... | | | | | 8,850 | 435 |
| Scup..... | 500 | 30 | | | 2,010 | 348 |
| Sea bass..... | 50 | 5 | | | 895 | 165 |
| Sharks..... | | | | | 303,225 | 3,037 |
| Skates..... | | | 500 | 10 | 2,845 | 71 |
| Smelt..... | 7,500 | 2,025 | 1,300 | 325 | 38,796 | 10,639 |
| Striped bass..... | | | | | 20 | 5 |
| Tautog..... | 7,100 | 640 | | | 50,225 | 5,732 |
| Tomcod..... | | | 1,000 | 50 | 1,000 | 50 |
| Tongues..... | | | | | 600 | 12 |
| Spawn..... | | | 12,964 | 944 | 14,546 | 1,031 |
| Livers..... | | | | | 85,150 | 1,276 |
| Total..... | 241,713 | 12,648 | 4,208,262 | 161,225 | 13,159,321 | 508,741 |
| Tongs, rakes, hoes, and forks: | | | | | | |
| Clams— | | | | | | |
| Hard— | | | | | | |
| Public..... | 35,960 | 11,933 | | | 700,904 | 225,367 |
| Private..... | | | | | 22,640 | 12,425 |
| Soft— | | | | | | |
| Public..... | 1,146,100 | 122,885 | 246,000 | 26,519 | 2,062,630 | 232,194 |
| Private..... | | | | | 125,000 | 10,750 |
| Razor..... | | | | | 23,300 | 3,500 |
| Oysters, market— | | | | | | |
| Public..... | 3,409 | 770 | | | 5,404 | 1,320 |
| Private..... | 7,000 | 2,500 | | | 236,180 | 73,750 |
| Scallops..... | | | | | 48 | 20 |
| Irish moss..... | 178,700 | 13,115 | | | 204,200 | 15,027 |
| Total..... | 1,371,169 | 151,203 | 246,000 | 26,519 | 3,380,306 | 574,353 |
| Eel pots: Eels..... | 9,200 | 1,148 | | | 155,421 | 22,327 |
| Lobster pots: | | | | | | |
| Lobsters..... | 575,829 | 119,580 | 71,385 | 21,415 | 2,365,014 | 512,080 |
| Crabs, hard..... | 8,000 | 165 | 1,720,319 | 48,310 | 1,764,961 | 49,424 |
| Total..... | 583,829 | 119,745 | 1,791,704 | 69,725 | 4,129,975 | 561,504 |
| Spears: | | | | | | |
| Eels..... | 500 | 55 | | | 31,441 | 5,442 |
| Flounders..... | | | | | 6,900 | 575 |
| Total..... | 500 | 55 | | | 38,341 | 6,017 |

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY BOW NETS, FYKE NETS, HARPOONS, COCKLE TRAPS, AND CUNNER TRAPS.

| Apparatus and species. | Barnstable. | | Bristol. | | Dukes. | | Essex. | | Total. | |
|-----------------------------|-------------|--------|----------|--------|---------|---------|---------|---------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Bow nets: Alewives— | | | | | | | | | | |
| Fresh..... | 41,500 | \$475 | ..... | ..... | ..... | ..... | ..... | ..... | 41,500 | \$475 |
| Salted..... | 162,000 | 7,280 | ..... | ..... | ..... | ..... | ..... | ..... | 162,000 | 7,280 |
| Smoked..... | 37,000 | 2,695 | ..... | ..... | ..... | ..... | ..... | ..... | 37,000 | 2,695 |
| Scales..... | 1,000 | 500 | ..... | ..... | ..... | ..... | ..... | ..... | 1,000 | 500 |
| Total..... | 241,500 | 10,950 | ..... | ..... | ..... | ..... | ..... | ..... | 241,500 | 10,950 |
| Fyke nets: | | | | | | | | | | |
| Eels..... | 33,180 | 6,577 | 10,600 | \$950 | 40,000 | \$8,000 | ..... | ..... | 83,780 | 15,527 |
| Flounders..... | ..... | ..... | 3,200 | 181 | ..... | ..... | ..... | ..... | 3,200 | 181 |
| Perch, white..... | ..... | ..... | 200 | 20 | ..... | ..... | ..... | ..... | 200 | 20 |
| Tomcod..... | ..... | ..... | 2,300 | 90 | ..... | ..... | ..... | ..... | 2,300 | 90 |
| Total..... | 33,180 | 6,577 | 16,300 | 1,241 | 40,000 | 8,000 | ..... | ..... | 89,480 | 15,818 |
| Harpoons: Swordfish..... | ..... | ..... | 2,400 | 600 | 15,500 | 2,620 | ..... | ..... | 17,900 | 3,220 |
| Cockle traps: Cockles..... | 1,450 | 725 | ..... | ..... | ..... | ..... | 300,000 | \$1,350 | 301,450 | 2,075 |
| Cunner traps: Cunnners..... | ..... | ..... | 7,150 | 500 | ..... | ..... | ..... | ..... | 7,150 | 500 |

WITHOUT APPARATUS.

| Species. | Barnstable. | | Plymouth. | | Total. | |
|-----------------------------|-------------|--------|-----------|--------|---------|--------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Blackfish..... | 40,000 | \$40 | ..... | ..... | 40,000 | \$40 |
| Clams, hard..... | 2,400 | 825 | 800 | \$250 | 3,200 | 1,075 |
| Oysters, seed, private..... | 51,688 | 4,430 | ..... | ..... | 51,688 | 4,430 |
| Cockles..... | 950 | 300 | 275,000 | 1,050 | 275,950 | 1,350 |
| Total..... | 95,038 | 5,595 | 275,800 | 1,300 | 370,838 | 6,895 |

INDUSTRIES.

Wholesale fishery trade.—In 1919 there were 139 wholesale fishery establishments in Massachusetts, valued at \$2,928,405, with a cash capital amounting to \$1,522,545, in which 1,468 persons were engaged, to whom \$1,790,495 were paid in wages.

Five of these firms engaged in the manufacture of oil and fertilizer incidental to their wholesale business. The quantity of fish oil manufactured amounted to 56,250 gallons, valued at \$60,147, and of fertilizer to 324,750 pounds, valued at \$2,000.

Smoked, canned, and by-product industries.—In the appended table the statistics of the smoked, canned, and by-product industries of Massachusetts in 1919 are shown in detail. The quantity of fish smoked, salted, and pickled amounted to 12,807,782 pounds, valued at \$863,927, the principal items being finnan haddie, 4,506,216 pounds, valued at \$352,692, and salted and pickled herring, 3,299,950 pounds, valued at \$100,530. The pack of canned products amounted to 52,474 cases, valued at \$362,926, and the value of the by-products was \$1,050,317.

INDUSTRIES OF MASSACHUSETTS IN 1919.

| Item. | Smoked fish, and salted and pickled herring. | | Canned. | | By-products. | | Total. | |
|--|--|-----------|---------------------|-------------|----------------------|-----------|------------|-------------|
| | Number. | Value. | Number. | Value. | Number. | Value. | Number. | Value. |
| Plants..... | ¹ 16 | \$694,688 | 6 | \$1,513,725 | ² 12 | \$447,389 | 34 | \$2,655,802 |
| Cost of materials..... | | 139,644 | | 654,079 | | | | |
| Cash capital..... | | 122,500 | | 154,500 | | 122,400 | | 399,400 |
| Persons engaged..... | 365 | | 1,490 | | 331 | | 2,186 | |
| Wages paid..... | | 332,979 | | 1,082,065 | | 428,929 | | 1,843,973 |
| MANUFACTURED PRODUCTS. | | | | | | | | |
| Liver and menhaden oil..gallons..... | | | | | ³ 207,627 | 236,110 | 207,627 | 236,110 |
| Liquid glue..do..... | | | | | ⁴ 388,252 | 474,924 | 388,252 | 474,924 |
| Fish scrap and fertilizer..pounds..... | | | | | 14,895,358 | 339,283 | 14,895,358 | 339,283 |
| Kippered herring, pounds..... | 233,378 | 28,440 | | | | | 233,378 | 28,440 |
| Finnan haddie, pounds..... | 4,506,216 | 352,692 | | | | | 4,506,216 | 352,692 |
| Smoked herring: Plain and Bismarks.pounds..... | 3,045,400 | 201,550 | | | | | 3,045,400 | 201,550 |
| Bloaters...do..... | 1,290,600 | 131,350 | | | | | 1,290,600 | 131,350 |
| Smoked alewives, halibut, salmon, and sharks, pounds..... | 432,238 | 49,365 | | | | | 432,238 | 49,365 |
| Salted and pickled herring.pounds..... | 3,299,950 | 100,530 | | | | | 3,299,950 | 100,530 |
| Clams (various sizes).....cases..... | | | 12,340 | 72,089 | | | 12,340 | 72,089 |
| Clam chowder and clam extract (various sizes).cases..... | | | 2,384 | 10,824 | | | 2,384 | 10,824 |
| Miscellaneous species of fish (various sizes).....cases..... | | | ⁵ 37,750 | 280,013 | | | 37,750 | 280,013 |
| Total..... | 12,807,782 | 863,927 | 52,474 | 302,926 | | 1,050,317 | | 2,277,170 |

¹ Does not include two plants which are shown under canning industry.

² Includes two menhaden plants operated in Connecticut.

³ Includes small quantities of shark, blackfish, and porpoise oils.

⁴ Includes a small quantity of dry glue.

⁵ Includes "sardines," cod, haddock, herring, mackerel, whiting, and fish roe.

FISHERIES OF RHODE ISLAND.

Rhode Island ranked third among the New England States in 1919 in the investment, quantity, and value of its fishery products, and fourth in the number of persons engaged. The number of persons employed was 1,646, of whom 317 were on fishing vessels, 44 on vessels transporting fishery products, 795 in the shore and boat fisheries, and 490 shoresmen in the wholesale fish establishments.

The investment amounted to \$2,249,536 and included 82 fishing and transporting vessels, valued at \$392,164, with a net tonnage of 1,594 tons and outfits valued at \$168,235; 628 power, sail, row, and other small boats, valued at \$187,283; apparatus employed in the vessel and boat fisheries to the value of \$314,496; shore and accessory property valued at \$978,622, and working cash capital to the amount of \$209,300.

The products of the fisheries amounted to 48,250,883 pounds, valued at \$3,296,578. The five most important species, arranged in the order of their value, were: Oysters, 6,261,759 pounds, or 894,537 bushels, valued at \$1,242,585; scup, 8,261,140 pounds, valued at \$817,846; lobsters, 1,694,327 pounds, valued at \$360,679; menhaden,

21,536,000 pounds, valued at \$268,700, and mackerel, 1,575,923 pounds, valued at \$146,611.

Compared with 1905, there has been a decrease of 566 in the number of persons employed in the fisheries of the State, but an increase in the investment amounting to \$1,184,062, in the total quantity of products of 24,354,640 pounds and in the value of \$1,749,920. There was a large increase in the catch of the following species as compared with 1905: Menhaden, 20,509,800 pounds in quantity and \$265,678 in value; scup, 2,721,100 pounds in quantity and \$679,816 in value; whiting, 1,313,630 pounds in quantity and \$12,244 in value; flounders, 1,308,114 pounds in quantity and \$44,139 in value; lobsters, 1,053,873 pounds in quantity and \$296,321 in value; and mackerel,

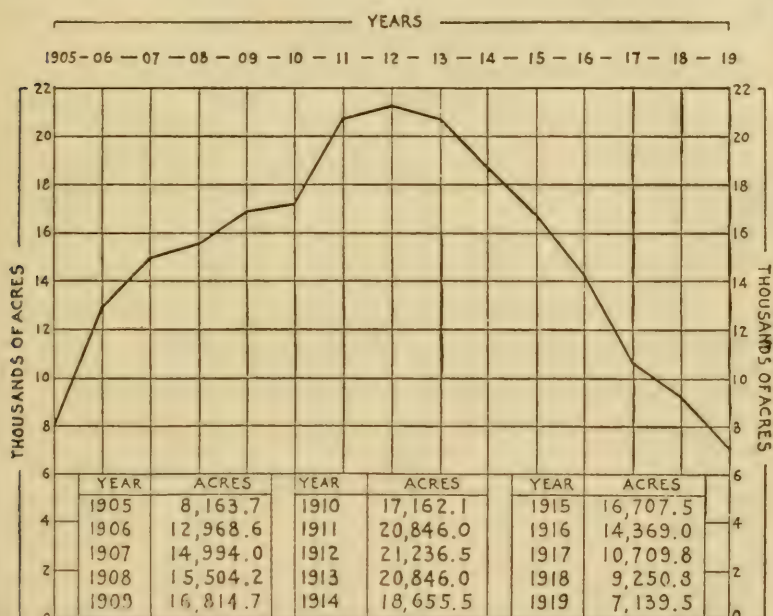


FIG. 9.—Acres of oyster ground leased to individuals in Rhode Island, by years, from 1905 to 1919, inclusive.

737,993 pounds in quantity and \$98,557 in value. The species for which there has been a significant decrease, with the amount of the decrease, follow: Squeteague, 2,868,925 pounds in quantity and \$52,649 in value; haddock, 505,435 pounds in quantity and \$14,276 in value; and alewives, 329,025 pounds in quantity and \$1,115 in value. No shad, hickory shad, or king whiting were reported in the catch in 1919. The take of Irish moss amounted to only 2,000 pounds, valued at \$240, in 1919, as compared with 16,000 pounds, valued at \$1,120, in 1905.

The accompanying graph (fig. 9), showing the number of acres of oyster ground leased to individuals in Rhode Island, by years, from 1905 to 1919, indicates with marked clearness the rise and fall in that State of its most important fishery. According to canvasses made by this Bureau, the yield in 1905 amounted to 916,088 bushels, in 1910 to 2,268,278 bushels, and in 1919 to 894,537 bushels, which substan-

tiates in a measure the general trend of the oyster industry as indicated by this graph.

Although the figures appearing in the appended table show the number of acres leased from the State, they do not represent the actual number of acres under cultivation during each year. From data secured in 1910 the number of acres under cultivation was 15,927.2, or 93 per cent of the total number leased during that year.

FISHERIES BY COUNTIES.

The statistics as to the number of persons employed, investment, and products of the fisheries in Rhode Island are given by counties in the following table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES.

| Items. | Bristol. | | Kent. | | Newport. | |
|-----------------------------------|----------|----------|---------|---------|----------|-----------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 24 | | 2 | | 211 | |
| On vessels transporting..... | 1 | | | | 33 | |
| In shore fisheries..... | 39 | | 104 | | 449 | |
| Shoresmen..... | 104 | | 48 | | 104 | |
| Total..... | 168 | | 134 | | 797 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Gasoline..... | 7 | \$25,300 | 1 | \$3,500 | 30 | \$92,200 |
| Tonnage..... | 113 | | 13 | | 406 | |
| Outfit..... | | 12,481 | | 1,200 | | 46,874 |
| Steam..... | | | | | 7 | 124,000 |
| Tonnage..... | | | | | 277 | |
| Outfit..... | | | | | | 45,950 |
| Vessels transporting: | | | | | | |
| Gasoline..... | 1 | 1,000 | | | 6 | 16,000 |
| Tonnage..... | 10 | | | | 55 | |
| Outfit..... | | 100 | | | | 4,600 |
| Steam..... | | | | | 5 | 22,000 |
| Tonnage..... | | | | | 77 | |
| Outfit..... | | | | | | 23,800 |
| Boats: | | | | | | |
| Sail, row, etc..... | 16 | 350 | 24 | 410 | 93 | 2,580 |
| Power..... | 22 | 6,175 | 76 | 20,065 | 229 | 117,290 |
| Apparatus, vessel fisheries: | | | | | | |
| Purse seines..... | | | | | 18 | 24,695 |
| Gill nets..... | | | | | 780 | 14,445 |
| Pound nets..... | | | | | 25 | 75,000 |
| Lines, hand and trawl..... | | | | | | 785 |
| Otter trawls..... | 1 | 45 | | | 14 | 688 |
| Harpoons..... | | | | | | 561 |
| Lobster pots..... | | | | | 410 | 1,310 |
| Dredges..... | 14 | 620 | 2 | 75 | 4 | 130 |
| Apparatus, shore fisheries: | | | | | | |
| Seines..... | 2 | 175 | | | 7 | 574 |
| Gill nets..... | | | | | 360 | 7,300 |
| Pound nets and trap nets..... | 6 | 1,800 | | | 75 | 70,350 |
| Fyke nets..... | | | 20 | 310 | 240 | 4,368 |
| Dip nets..... | | | | | 30 | 450 |
| Lines, hand and trawl..... | | 42 | | | | 4,185 |
| Otter trawls..... | | | | | 39 | 2,270 |
| Harpoons..... | | | | | | 690 |
| Lobster pots..... | 321 | 1,030 | 146 | 413 | 15,942 | 47,610 |
| Eel pots..... | 480 | 530 | | | 60 | 85 |
| Dredges..... | 12 | 122 | 142 | 744 | 40 | 218 |
| Tongs..... | 21 | 185 | 92 | 743 | 58 | 583 |
| Rakes..... | 1 | 5 | 5 | 40 | 7 | 27 |
| Hoes..... | 12 | 12 | 54 | 54 | 7 | 7 |
| Grabs..... | | | | | 6 | 18 |
| Shovels..... | 10 | 10 | 11 | 11 | | |
| Winkle pots..... | | | | | 260 | 880 |
| Shore and accessory property..... | | 107,982 | | 9,562 | | 462,753 |
| Cash capital..... | | 34,500 | | 4,800 | | 79,000 |
| Total..... | | 192,464 | | 41,927 | | 1,294,276 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF RHODE ISLAND
IN 1919, BY COUNTIES—Continued.

| Items. | Bristol. | | Kent. | | Newport. | |
|-------------------------------|-----------|---------|---------|--------|------------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| PRODUCTS. | | | | | | |
| Alewives..... | | | | | 260,550 | \$5,736 |
| Bluefish..... | | | | | 21,345 | 2,485 |
| Bonito..... | | | | | 114,810 | 10,825 |
| Butterfish..... | 20,000 | \$1,000 | | | 712,320 | 36,592 |
| Cod..... | | | | | 1,123,331 | 48,647 |
| Cunner..... | | | | | 8,000 | 960 |
| Eels..... | 67,450 | 7,042 | | | 131,730 | 14,075 |
| Flounders..... | 41,330 | 1,240 | 510 | \$15 | 1,687,699 | 53,740 |
| Haddock..... | | | | | 10,300 | 512 |
| Herring..... | | | | | 144,550 | 3,509 |
| Mackerel..... | | | | | 1,531,423 | 141,689 |
| Menhaden..... | | | | | 21,536,000 | 268,700 |
| Perch, white..... | | | | | 5,043 | 702 |
| Pollock..... | | | | | 95,400 | 5,920 |
| Seep..... | | | | | 8,206,000 | 812,456 |
| Sea bass..... | | | | | 48,741 | 5,454 |
| Squeteague..... | | | | | 285,440 | 26,675 |
| Swordfish..... | | | | | 101,010 | 19,757 |
| Tautog..... | 30,780 | 1,561 | 280 | 15 | 274,825 | 15,275 |
| Tuna..... | | | | | 50,130 | 4,010 |
| Whiting..... | | | | | 1,405,200 | 14,140 |
| Lobster..... | 24,300 | 4,780 | 9,413 | 1,993 | 1,270,562 | 273,086 |
| Crabs..... | | | | | 26,000 | 1,300 |
| Squid..... | | | | | 180,265 | 8,065 |
| Clams: | | | | | | |
| Hard..... | 5,560 | 2,130 | 49,944 | 18,845 | 34,544 | 13,106 |
| Soft..... | 15,290 | 919 | 108,120 | 6,432 | 23,160 | 1,268 |
| Scallops..... | 400 | 200 | 31,074 | 13,125 | 2,016 | 1,032 |
| Mussels..... | | | | | 10,000 | 1,000 |
| Winkles..... | | | | | 10,500 | 2,100 |
| Oysters, market, private..... | 1,481,942 | 282,592 | 81,508 | 16,124 | 56,700 | 11,472 |
| Irish moss..... | | | | | 2,000 | 240 |
| Total..... | 1,687,052 | 301,464 | 280,849 | 56,549 | 39,373,594 | 1,804,528 |

| Items. | Providence. | | Washington. | | Total. | |
|------------------------------|-------------|----------|-------------|----------|---------|-----------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| PERSONS ENGAGED. | | | | | | |
| On vessels fishing..... | 55 | | 25 | | 317 | |
| On vessels transporting..... | 2 | | 8 | | 44 | |
| In shore fisheries..... | 73 | | 139 | | 795 | |
| Shoresmen..... | 231 | | 23 | | 490 | |
| Total..... | 361 | | 186 | | 1,646 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Gasoline..... | 7 | \$52,000 | 10 | \$26,400 | 55 | \$199,400 |
| Tonnage..... | 229 | | 88 | | 849 | |
| Outfit..... | | 13,520 | | 7,950 | | 82,025 |
| Steam..... | 2 | 17,000 | | | 9 | 141,000 |
| Tonnage..... | 87 | | | | 564 | |
| Outfit..... | | 5,960 | | | | 51,910 |
| Vessels transporting: | | | | | | |
| Gasoline..... | 1 | 1,200 | 5 | 11,000 | 13 | 29,200 |
| Tonnage..... | 5 | | 31 | | 104 | |
| Outfit..... | | 1,400 | | 4,400 | | 10,500 |
| Steam..... | | | | | 5 | 22,000 |
| Tonnage..... | | | | | 77 | |
| Outfit..... | | | | | | 23,800 |
| Boats: | | | | | | |
| Sail, row, etc..... | 29 | 483 | 34 | 680 | 196 | 4,503 |
| Power..... | 21 | 4,575 | 84 | 34,675 | 432 | 152,780 |
| Apparatus, vessel fisheries: | | | | | | |
| Purse seines..... | | | | | 18 | 24,695 |
| Gill nets..... | | | | | 780 | 14,445 |
| Pound nets..... | | | | | 25 | 75,000 |
| Lines, hand and trawl..... | | | | | | 785 |
| Otter trawls..... | | | 5 | 240 | 20 | 973 |
| Harpoons..... | | | | | | 561 |
| Lobster pots..... | | | 225 | 675 | 635 | 1,985 |
| Dredges..... | 20 | 955 | 8 | 312 | 48 | 2,092 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF RHODE ISLAND
IN 1919, BY COUNTIES—Continued.

| Items. | Providence. | | Washington. | | Total. | |
|-----------------------------------|-------------|---------|-------------|---------|------------|-----------|
| INVESTMENT—continued. | | | | | | |
| Apparatus, shore fisheries: | Number. | Value. | Number. | Value. | Number. | Value. |
| Sekins..... | 1 | \$50 | 1 | \$100 | 11 | \$899 |
| Gill nets..... | | | | | 360 | 7,300 |
| Pound nets and trap nets..... | | | 27 | 29,600 | 108 | 101,750 |
| Fyke nets..... | | | 30 | 540 | 290 | 5,218 |
| Dip nets..... | | | | | 30 | 450 |
| Lines, hand and trawl..... | | | | 265 | | 4,492 |
| Otter trawls..... | | | 4 | 155 | 43 | 2,425 |
| Harpoons..... | | | | | | 690 |
| Lobster pots..... | | | 5,527 | 16,293 | 21,936 | 65,346 |
| Eel pots..... | 230 | 255 | 175 | 165 | 995 | 1,035 |
| Dredges..... | | | 7 | 35 | 201 | 1,119 |
| Tongs..... | 62 | 405 | 8 | 65 | 241 | 1,981 |
| Rakes..... | 4 | 16 | 12 | 78 | 29 | 166 |
| Hoes..... | 55 | 53 | 24 | 22 | 152 | 148 |
| Grabs..... | | | | | 6 | 18 |
| Shovels..... | 22 | 22 | | | 43 | 43 |
| Winkle pots..... | | | | | 260 | 880 |
| Shore and accessory property..... | | 370,570 | | 27,755 | | 978,622 |
| Cash capital..... | | 81,500 | | 9,500 | | 209,300 |
| Total..... | | 549,964 | | 170,905 | | 2,249,536 |
| PRODUCTS. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Alewives..... | | | 9,015 | \$180 | 269,565 | \$5,916 |
| Bluefish..... | | | 4,330 | 685 | 25,675 | 3,170 |
| Bonito..... | | | | | 114,810 | 10,825 |
| Butterfish..... | | | 26,525 | 1,596 | 758,845 | 39,188 |
| Cod..... | | | 25,000 | 1,160 | 1,148,331 | 49,747 |
| Cunner..... | | | | | 8,000 | 960 |
| Eels..... | 25,390 | \$2,698 | 50,165 | 5,822 | 274,735 | 29,637 |
| Flounders..... | | | 722,040 | 24,572 | 2,451,579 | 79,567 |
| Haddock..... | | | | | 10,300 | 512 |
| Herring..... | | | 25,110 | 501 | 169,660 | 4,010 |
| Mackerel..... | | | 44,500 | 4,922 | 1,575,923 | 146,611 |
| Menhaden..... | | | | | 21,536,000 | 268,700 |
| Perch, white..... | | | | | 5,043 | 702 |
| Pollock..... | | | | | 99,400 | 5,920 |
| Salmon..... | | | 70 | 12 | 70 | 12 |
| Scup..... | | | 55,140 | 5,390 | 8,261,140 | 817,846 |
| Sea bass..... | | | 3,300 | 500 | 52,041 | 5,954 |
| Squeteague..... | | | 68,420 | 7,154 | 353,860 | 33,829 |
| Striped bass..... | | | 33,705 | 5,236 | 33,705 | 5,236 |
| Swordfish..... | | | | | 101,010 | 19,757 |
| Tautog..... | | | 65,775 | 5,340 | 371,660 | 22,191 |
| Tuna..... | | | 11,220 | 800 | 61,350 | 4,810 |
| Whiting..... | | | 178,500 | 1,870 | 1,583,700 | 16,010 |
| Lobster..... | | | 390,052 | 80,820 | 1,694,327 | 360,679 |
| Crabs..... | | | 8,330 | 502 | 34,330 | 1,802 |
| Squid..... | | | 197,314 | 10,665 | 377,579 | 18,730 |
| Clams: | | | | | | |
| Hard..... | 27,128 | 10,918 | 39,056 | 14,650 | 1156,232 | 59,649 |
| Soft..... | 205,770 | 12,371 | 51,420 | 3,085 | 2403,766 | 24,075 |
| Scallops..... | | | 504 | 251 | 33,994 | 14,608 |
| Mussels..... | | | | | 410,000 | 1,000 |
| Winkles..... | | | | | 610,500 | 2,100 |
| Oysters, market, private..... | 4,428,018 | 885,600 | 213,691 | 46,797 | 66,261,759 | 1,242,585 |
| Irish moss..... | | | | | 2,000 | 240 |
| Total..... | 4,686,306 | 911,587 | 2,224,082 | 222,450 | 48,250,883 | 3,296,578 |

¹ 19,629 bushels. ² 40,376 bushels. ³ 5,666 bushels. ⁴ 1,000 bushels. ⁵ 1,050 bushels. ⁶ 894,537 bushels.

FISHERIES BY APPARATUS.

The combined yield of all forms of apparatus employed in the vessel and shore fisheries of Rhode Island in 1919 amounted to 48,250,883 pounds, valued at \$3,296,578. Dredges employed principally in the oyster vessel fishery were the most productive form of apparatus, yielding 6,142,623 pounds of oysters and mussels, valued at \$1,217,637; while dredges, tongs, rakes, hoes, shovels, and grabs used in the shore fisheries took 723,122 pounds of oysters, clams,

and scallops, valued at \$124,280. Pound nets used in both the vessel and shore fisheries yielded 13,759,923 pounds, valued at \$1,051,315, of which 8,261,140 pounds, valued at \$799,846, were scup. Other important species taken in pound nets were: Butterfish, 625,095 pounds, valued at \$32,493; mackerel, 321,343 pounds, valued at \$30,139; squeteague, 311,260 pounds, valued at \$29,574; and flounders, 911,965 pounds, valued at \$27,574. The catch with pots amounted to 1,790,182 pounds, valued at \$370,399. Lobsters were the principal species taken in pots, amounting to 1,694,327 pounds, valued at \$360,679. Purse seines yielded 21,959,000 pounds, valued at \$308,150, of which 21,536,000 pounds were menhaden, valued at \$268,700, and 423,200 pounds were mackerel, valued at \$39,450.

Other important forms of apparatus employed in both the vessel and shore fisheries, arranged in the order of their importance, based on the value of their catch, were: Lines, with 1,389,986 pounds, mostly cod, bonito, and eels, valued at \$75,724; gill nets, with 759,980 pounds of mackerel, valued at \$70,632; otter trawls, with 1,481,340 pounds, valued at \$50,389, consisting principally of flounders; and harpoons, with 101,010 pounds of swordfish, valued at \$19,757.

The catch of winkles with pots amounted to 10,500 pounds, valued at \$2,100. These are caught in winkle pots and are used for bait for cod. The pots are similar to the ordinary lobster pots, with the entrance at the top instead of at the end. The bait employed in the pots is of about the same character as that used in lobster pots.

The following tables give the products of the vessel and shore fisheries of Rhode Island in 1919, by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

| Apparatus and species. | Bristol. | | Kent. | | Newport. | |
|------------------------------|----------|--------|---------|--------|------------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Purse seines: | | | | | | |
| Mackerel..... | | | | | 423,200 | \$39,450 |
| Menhaden..... | | | | | 21,536,000 | 268,700 |
| Total..... | | | | | 21,959,200 | 308,150 |
| Gill nets: Mackerel..... | | | | | 519,450 | 48,385 |
| Pound nets: | | | | | | |
| Alewives..... | | | | | 60,110 | 1,202 |
| Bluefish..... | | | | | 11,200 | 1,140 |
| Butterfish..... | | | | | 133,750 | 6,695 |
| Cod..... | | | | | 40,100 | 2,010 |
| Eels..... | | | | | 3,520 | 452 |
| Flounders..... | | | | | 465,300 | 13,950 |
| Mackerel..... | | | | | 23,100 | 1,890 |
| Scup..... | | | | | 7,685,500 | 764,000 |
| Sea bass..... | | | | | 1,500 | 160 |
| Squeteague..... | | | | | 41,800 | 4,160 |
| Tautog..... | | | | | 13,550 | 675 |
| Whiting..... | | | | | 751,000 | 7,510 |
| Squid..... | | | | | 45,100 | 2,015 |
| Total..... | | | | | 9,275,530 | 805,859 |
| Lines: | | | | | | |
| Cod..... | | | | | 846,711 | 37,280 |
| Pollock..... | | | | | 34,000 | 1,750 |
| Tautog..... | | | | | 8,000 | 600 |
| Total..... | | | | | 888,711 | 39,630 |
| Otter trawls: Flounders..... | 5,000 | \$150 | | | 830,500 | 28,075 |
| Harpoons: Swordfish..... | | | | | 42,100 | 7,910 |

YIELD OF VESSEL FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

| Apparatus and species. | Bristol. | | Kent. | | Newport. | |
|-------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Lobster pots: | | | | | | |
| Lobsters..... | | | | | 17, 500 | \$3, 830 |
| Crabs..... | | | | | 26, 000 | 1, 300 |
| Total..... | | | | | 43, 500 | 5, 130 |
| Dredges: | | | | | | |
| Mussels..... | | | | | 10, 000 | 1, 000 |
| Oysters, market, private..... | 1, 418, 942 | \$269, 992 | 21, 000 | \$4, 020 | 54, 950 | 11, 000 |
| Total..... | 1, 418, 942 | 269, 992 | 21, 000 | 4, 020 | 64, 950 | 12, 000 |
| Grand total..... | 1, 423, 942 | 270, 142 | 21, 000 | 4, 020 | 33, 623, 941 | 1, 255, 139 |

| Apparatus and species. | Providence. | | Washington. | | Total. | |
|-------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Purse seines: | | | | | | |
| Mackerel..... | | | | | 423, 200 | \$39, 450 |
| Menhaden..... | | | | | 21, 536, 000 | 268, 700 |
| Total..... | | | | | 21, 959, 000 | 308, 150 |
| Gill nets: Mackerel..... | | | | | 519, 450 | 48, 385 |
| Pound nets: | | | | | | |
| Alewives..... | | | | | 60, 110 | 1, 202 |
| Bluefish..... | | | | | 11, 200 | 1, 140 |
| Butterfish..... | | | | | 133, 750 | 6, 695 |
| Cod..... | | | | | 40, 100 | 2, 010 |
| Eels..... | | | | | 3, 520 | 452 |
| Flounders..... | | | | | 465, 300 | 13, 950 |
| Mackerel..... | | | | | 23, 100 | 1, 890 |
| Scup..... | | | | | 7, 085, 500 | 764, 000 |
| Sea bass..... | | | | | 1, 500 | 160 |
| Squeteague..... | | | | | 41, 800 | 4, 160 |
| Tautog..... | | | | | 13, 550 | 675 |
| Whiting..... | | | | | 751, 000 | 7, 510 |
| Squid..... | | | | | 45, 100 | 2, 015 |
| Total..... | | | | | 9, 275, 530 | 805, 859 |
| Lines: | | | | | | |
| Cod..... | | | | | 846, 711 | 37, 280 |
| Pollock..... | | | | | 34, 000 | 1, 750 |
| Tautog..... | | | | | 8, 000 | 600 |
| Total..... | | | | | 888, 711 | 39, 630 |
| Otter trawls: Flounders..... | | | 365, 200 | \$13, 490 | 1, 200, 700 | 41, 715 |
| Harpoons: Swordfish..... | | | | | 42, 100 | 7, 910 |
| Lobster pots: | | | | | | |
| Lobsters..... | | | 16, 500 | 3, 500 | 34, 000 | 7, 330 |
| Crabs..... | | | | | 26, 000 | 1, 300 |
| Total..... | | | 16, 500 | 3, 500 | 60, 000 | 8, 630 |
| Dredges: | | | | | | |
| Mussels..... | | | | | 10, 000 | 1, 000 |
| Oysters, market, private..... | 4, 427, 500 | \$885, 500 | 210, 231 | 46, 125 | 6, 132, 623 | 1, 216, 637 |
| Total..... | 4, 427, 500 | 885, 500 | 210, 231 | 46, 125 | 6, 142, 623 | 1, 217, 637 |
| Grand total..... | 4, 427, 500 | 885, 500 | 591, 931 | 63, 115 | 40, 088, 314 | 2, 477, 916 |

YIELD OF SHORE FISHERIES OF RHODE ISLAND IN 1919, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES, POUND NETS, AND LINES.

| Apparatus and species. | Bristol. | | Newport. | | Providence. | | Washington. | | Total. | |
|------------------------|----------|--------|-----------|---------|-------------|---------|-------------|--------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Seines: | | | | | | | | | | |
| Eels..... | | | | | 10,920 | \$1,211 | | | 10,920 | \$1,211 |
| Flounders..... | 5,090 | \$150 | | | | | | | 5,090 | 150 |
| Herring..... | | | 30,160 | \$758 | | | | | 30,160 | 758 |
| Mackerel..... | | | | | | | 6,300 | \$700 | 6,300 | 700 |
| Perch, white..... | | | 5,043 | 702 | | | | | 5,043 | 702 |
| Tautog..... | 10,000 | 500 | | | | | | | 10,000 | 500 |
| Total..... | 15,000 | 650 | 35,203 | 1,460 | 10,920 | 1,211 | 6,300 | 700 | 67,423 | 4,021 |
| Pound nets: | | | | | | | | | | |
| Alcwives..... | | | 200,440 | 4,534 | | | 9,015 | 180 | 209,455 | 4,714 |
| Bluefish..... | | | 10,145 | 1,345 | | | 4,330 | 685 | 14,475 | 2,030 |
| Bonito..... | | | 39,810 | 3,320 | | | | | 39,810 | 3,320 |
| Butterfish..... | 20,000 | 1,000 | 578,570 | 29,897 | | | 26,525 | 1,596 | 625,095 | 32,493 |
| Cod..... | | | 73,840 | 2,730 | | | 25,000 | 1,100 | 98,840 | 3,830 |
| Eels..... | 20,000 | 2,000 | 117,900 | 12,184 | | | 4,500 | 450 | 142,400 | 14,634 |
| Flounders..... | 30,000 | 900 | 175,985 | 5,292 | | | 240,680 | 7,432 | 446,665 | 13,624 |
| Herring..... | | | 114,390 | 2,751 | | | 25,110 | 501 | 139,500 | 3,252 |
| Mackerel..... | | | 281,943 | 26,117 | | | 36,400 | 4,022 | 321,343 | 30,139 |
| Pollock..... | | | 44,400 | 2,680 | | | | | 44,400 | 2,680 |
| Salmon..... | | | | | | | 70 | 12 | 70 | 12 |
| Scup..... | | | 520,500 | 18,456 | | | 55,140 | 5,390 | 575,640 | 53,846 |
| Sea bass..... | | | 46,231 | 5,255 | | | 3,300 | 500 | 49,531 | 5,755 |
| Squeteague..... | | | 243,640 | 22,515 | | | 67,620 | 7,059 | 311,260 | 29,574 |
| Striped bass..... | | | | | | | 31,555 | 4,836 | 31,555 | 4,836 |
| Tautog..... | 20,000 | 1,000 | 199,065 | 10,642 | | | 39,890 | 3,140 | 258,865 | 14,782 |
| Tuna..... | | | | | | | 10,220 | 720 | 10,220 | 720 |
| Whiting..... | | | 651,200 | 6,630 | | | 178,500 | 1,870 | 832,700 | 8,500 |
| Squid..... | | | 135,165 | 6,050 | | | 197,314 | 10,665 | 332,479 | 16,715 |
| Total..... | 90,000 | 4,900 | 4,429,314 | 190,388 | | | 955,079 | 50,158 | 4,484,393 | 245,456 |
| Lines: | | | | | | | | | | |
| Bonito..... | | | 75,000 | 7,505 | | | | | 75,000 | 7,505 |
| Cod..... | | | 162,680 | 6,627 | | | | | 162,680 | 6,627 |
| Eels..... | 15,000 | 1,600 | 6,200 | 1,010 | | | 37,250 | 4,410 | 58,450 | 7,020 |
| Flounders..... | 1,330 | 40 | | | | | 21,550 | 740 | 22,880 | 780 |
| Mackerel..... | | | 10,000 | 3,000 | | | 1,800 | 200 | 12,000 | 3,800 |
| Pollock..... | | | 21,000 | 1,490 | | | | | 21,000 | 1,490 |
| Sea bass..... | | | 1,010 | 39 | | | | | 1,010 | 39 |
| Squeteague..... | | | | | | | 800 | 95 | 800 | 95 |
| Striped bass..... | | | | | | | 2,150 | 400 | 2,150 | 400 |
| Tautog..... | 780 | 61 | 29,030 | 1,485 | | | 25,975 | 2,200 | 55,815 | 3,746 |
| Tuna..... | | | 50,130 | 4,010 | | | 1,000 | 80 | 51,130 | 4,090 |
| Crabs..... | | | | | | | 8,330 | 502 | 8,330 | 502 |
| Total..... | 17,110 | 1,701 | 385,310 | 25,769 | | | 98,885 | 8,627 | 501,275 | 36,094 |

BY GILL NETS, FYKE NETS, DIP NETS, OTTER TRAWLS, AND HARPOONS.

| Apparatus and species. | Kent. | | Newport. | | Washington. | | Total. | |
|--------------------------|---------|--------|----------|----------|-------------|--------|---------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Gill nets: Mackerel..... | | | 240,530 | \$22,247 | | | 240,530 | \$22,247 |
| Fyke nets: | | | | | | | | |
| Flounders..... | 510 | \$15 | 35,184 | 1,021 | 5,000 | \$150 | 40,694 | 1,186 |
| Tautog..... | 280 | 15 | 25,120 | 1,873 | | | 25,400 | 1,888 |
| Total..... | 790 | 30 | 60,304 | 2,894 | 5,000 | 150 | 66,094 | 3,074 |
| Dip nets: Cunner..... | | | 8,000 | 960 | | | 8,000 | 960 |
| Otter trawls: | | | | | | | | |
| Flounders..... | | | 180,730 | 5,402 | 89,610 | 2,760 | 270,340 | 8,162 |
| Haddock..... | | | 10,300 | 512 | | | 10,300 | 512 |
| Total..... | | | 191,030 | 5,914 | 89,610 | 2,760 | 280,640 | 8,674 |
| Harpoons: Swordfish..... | | | 58,910 | 11,847 | | | 58,910 | 11,847 |
| Grand total..... | 790 | 30 | 558,774 | 13,962 | 94,610 | 2,910 | 654,174 | 46,892 |

YIELD OF SHORE FISHERIES OF RHODE ISLAND IN 1919, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY POTS.

| Species. | Bristol. | | Kent. | | Newport. | |
|---------------|----------|---------|---------|---------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Eels..... | 32,450 | \$3,442 | | | 4,020 | \$429 |
| Lobsters..... | 24,300 | 4,780 | 9,413 | \$1,993 | 1,253,062 | 269,256 |
| Winkles..... | | | | | 10,500 | 2,100 |
| Total..... | 56,750 | 8,222 | 9,413 | 1,993 | 1,267,582 | 271,785 |

| Species. | Providence. | | Washington. | | Total. | |
|---------------|-------------|---------|-------------|--------|-----------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Eels..... | 14,470 | \$1,487 | 8,415 | \$962 | 59,355 | \$6,320 |
| Lobsters..... | | | 373,552 | 77,320 | 1,660,327 | 353,349 |
| Winkles..... | | | | | 10,500 | 2,100 |
| Total..... | 14,470 | 1,487 | 381,967 | 78,282 | 1,730,182 | 361,769 |

BY DREDGES, TONGS, RAKES, HOES, SHOVELS, GRABS, AND HANDS.

| Species. | Bristol. | | Kent. | | Newport. | |
|-------------------------------|----------|---------|---------|----------|----------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Clams: | | | | | | |
| Hard..... | 5,560 | \$2,130 | 49,944 | \$18,845 | 34,544 | \$13,106 |
| Soft..... | 15,290 | 919 | 108,120 | 6,432 | 23,160 | 1,268 |
| Scallops..... | 400 | 200 | 31,074 | 13,125 | 2,016 | 1,032 |
| Oysters, market, private..... | 63,000 | 12,600 | 60,508 | 12,104 | 1,750 | 472 |
| Irish moss..... | | | | | 2,000 | 240 |
| Total..... | 84,250 | 15,849 | 249,646 | 50,506 | 63,470 | 16,118 |

| Species. | Providence. | | Washington. | | Total. | |
|-------------------------------|-------------|----------|-------------|----------|---------|----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Clams: | | | | | | |
| Hard..... | 27,128 | \$10,918 | 39,056 | \$14,650 | 156,232 | \$59,649 |
| Soft..... | 205,770 | 12,371 | 51,420 | 3,085 | 403,760 | 24,075 |
| Scallops..... | | | 504 | 251 | 33,994 | 14,608 |
| Oysters, market, private..... | 518 | 100 | 3,360 | 672 | 129,136 | 25,948 |
| Irish moss..... | | | | | 2,000 | 240 |
| Total..... | 233,416 | 23,389 | 94,340 | 18,658 | 725,122 | 124,520 |

WHOLESALE FISHERY TRADE.

The appended table shows the extent of the wholesale trade in Rhode Island in 1919. A considerable quantity of poultry grit, made by grinding oyster shells, was manufactured by one concern. To avoid the disclosure of individual enterprise the products of this plant are not included in the table.

WHOLESALE TRADE IN FRESH FISH, OYSTERS, CLAMS, SCALLOPS, AND LOBSTERS IN RHODE ISLAND IN 1919.¹

| Item. | Number. | Value. | Item. | Number. | Value. |
|---------------------|---------|-----------|----------------------|---------|-----------|
| Establishments..... | 40 | \$928,355 | Persons engaged..... | 472 | |
| Cash capital..... | | 209,300 | Wages paid..... | | \$422,330 |

¹ Includes one firm engaged in the manufacture of oyster-shell grit.

FISHERIES OF CONNECTICUT.

In 1919 Connecticut ranked third in the number of persons engaged and fourth in the investment and quantity and value of the products. The number of persons employed on fishing and transporting vessels was 647, in the shore or boat fisheries 1,019, and in the wholesale establishments, including the fertilizer plants, 623, representing a total of 2,289. The investment amounted to \$1,645,793, which includes 123 fishing and transporting vessels, valued at \$546,163, with a net tonnage of 3,869 tons and outfits valued at \$253,888; 763 power, sail, row, and other boats, valued at \$146,551; fishing apparatus employed in the vessel and shore fisheries to the value of \$101,992; shore and accessory property valued at \$498,699; and working cash capital to the amount of \$98,500.

The products of the fisheries amounted to 23,652,647 pounds, valued at \$1,700,638. The most important products were oysters, 12,197,703 pounds, or 1,742,529 bushels, valued at \$1,087,016; menhaden, 6,736,564 pounds, valued at \$93,312; flounders, 2,349,181 pounds, valued at \$91,962; lobsters, 740,848 pounds, valued at \$189,157; and shad, 463,203 pounds, valued at \$86,637.

Compared with 1905, there has been a decrease in the number of persons employed of 1,118, an increase in the investment amounting to \$10,040, and a decrease in the quantity of products taken amounting to 51,320,001 pounds and in the value amounting to \$1,473,310. The species for which the decrease in 1919 has been most marked as compared with 1905, with the amount of decrease, follow: Menhaden, 22,993,824 pounds; alewives, 1,054,878 pounds; swordfish, 362,287 pounds; squeteague, 138,503 pounds; bluefish, 124,292 pounds; and sea bass, 93,161 pounds. In the oyster fishery there has been a decrease, compared with the catch in 1905, amounting to 1,944,895 bushels, or 52.74 per cent, and with the catch in 1910, of 1,529,471 bushels, or 46.74 per cent.

FISHERIES BY COUNTIES.

Statistics of the number of persons employed, investment, and products of the fisheries in Connecticut are given by counties in the following table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT IN 1919, BY COUNTIES.

| Item. | Fairfield. | | Hartford. | | Middlesex. | |
|------------------------------|------------|-----------|-----------|--------|------------|--------|
| | Number. | Value. | Number. | Value. | Number. | Value. |
| PERSONS ENGAGED. | | | | | | |
| On vessels fishing..... | 337 | | | | | |
| On vessels transporting..... | 22 | | | | | |
| In shore fisheries..... | 88 | | 126 | | 275 | |
| Shoremen..... | 254 | | | | 2 | |
| Total..... | 701 | | 126 | | 277 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Steam..... | 16 | \$195,193 | | | | |
| Tonnage..... | 1,116 | | | | | |
| Outfit..... | | 104,938 | | | | |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT
IN 1919, BY COUNTIES—Continued.

| Item. | Fairfield. | | Hartford. | | Middlesex. | |
|------------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| INVESTMENT—continued. | | | | | | |
| Vessels fishing—Continued. | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> | <i>Number.</i> | <i>Value.</i> |
| Gasoline..... | 41 | \$98,025 | | | | |
| Tonnage..... | 568 | | | | | |
| Outfit..... | | 53,740 | | | | |
| Sail..... | 19 | 9,195 | | | | |
| Tonnage..... | 135 | | | | | |
| Outfit..... | | 5,035 | | | | |
| Vessels transporting: | | | | | | |
| Steam..... | 2 | 13,200 | | | | |
| Tonnage..... | 111 | | | | | |
| Outfit..... | | 9,627 | | | | |
| Boats: | | | | | | |
| Sail, row, etc..... | 35 | 2,040 | 73 | \$1,582 | 73 | \$1,814 |
| Power..... | 39 | 11,325 | 8 | 825 | 93 | 22,455 |
| Apparatus, vessel fisheries: | | | | | | |
| Otter trawls..... | 7 | 300 | | | | |
| Harpoons..... | | 30 | | | | |
| Lobster pots..... | 430 | 645 | | | | |
| Dredges..... | 289 | 5,398 | | | | |
| Apparatus, shore fisheries: | | | | | | |
| Seines..... | 6 | 710 | 27 | 1,834 | 17 | 1,244 |
| Gill nets..... | 1 | 10 | 83 | 1,066 | 92 | 9,369 |
| Pound nets..... | | | | | 9 | 2,935 |
| Fyke nets..... | | | 266 | 2,043 | 37 | 447 |
| Scoop nets..... | | | 3 | 15 | | |
| Otter trawls..... | 3 | 110 | | | 7 | 280 |
| Lobster pots..... | 2,085 | 4,060 | | | 1,353 | 3,053 |
| Bel pots..... | | | | | 145 | 123 |
| Dredges..... | 51 | 359 | | | | |
| Tongs..... | 28 | 190 | | | 6 | 55 |
| Rakes..... | 17 | 116 | | | | |
| Hoes..... | 8 | 10 | | | 15 | 18 |
| Shore and accessory property | | 279,084 | | 1,703 | | 7,986 |
| Cash capital..... | | 29,000 | | | | |
| Total..... | | 821,440 | | 9,068 | | 49,779 |
| PRODUCTS. | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Alewives..... | | | 40,161 | \$2,008 | 98,713 | \$2,122 |
| Bluefish..... | | | 965 | 95 | | |
| Bullheads..... | | | 60 | 6 | 365 | 17 |
| Butterfish..... | | | | | 50 | 3 |
| Carp..... | | | 11,854 | 1,637 | 18,509 | 2,145 |
| Eels..... | | | 4,768 | 1,038 | 6,420 | 608 |
| Flounders..... | 85,105 | \$3,727 | | | 184,160 | 6,202 |
| Menhaden..... | 300 | 25 | | | 18,314 | 1,110 |
| Perch, yellow..... | | | 2,434 | 235 | 1,213 | 109 |
| Pickarel..... | | | 128 | 20 | 340 | 35 |
| Shad..... | | | 34,959 | 8,627 | 329,829 | 59,309 |
| Smelt..... | 4,114 | 886 | | | | |
| Squid/cogue..... | | | | | 2,721 | 231 |
| Striped bass..... | | | | | 850 | 110 |
| Sturgeon..... | | | | | 25 | 5 |
| Suckers..... | | | 55,576 | 4,564 | 28,527 | 1,018 |
| Sunfish..... | | | 80 | 8 | 25 | 3 |
| Swordfish..... | 1,480 | 295 | | | | |
| Tautog..... | | | | | 809 | 61 |
| Lobsters..... | 72,924 | 23,885 | | | 80,355 | 23,092 |
| Clams: | | | | | | |
| Hard..... | 39,472 | 14,589 | | | | |
| Soft..... | 8,000 | 725 | | | 12,200 | 804 |
| Oysters: | | | | | | |
| Market— | | | | | | |
| Public..... | 18,942 | 2,880 | | | 4,004 | 810 |
| Private..... | 2,570,197 | 227,935 | | | 5,614 | 1,001 |
| Seed— | | | | | | |
| Public..... | 633,885 | 58,345 | | | | |
| Private..... | 4,976,454 | 372,677 | | | | |
| Total..... | 8,410,873 | 705,969 | 150,985 | 18,238 | 793,043 | 99,695 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT
IN 1919, BY COUNTIES—Continued.

| Item. | New Haven. | | New London. | | Total. | |
|-----------------------------------|------------|----------|-------------|----------|-----------|-----------|
| PERSONS ENGAGED. | Number. | Value. | Number. | Value. | Number. | Value. |
| On vessels fishing..... | 142 | | 87 | | 566 | |
| On vessels transporting..... | 59 | | | | 81 | |
| In shore fisheries..... | 272 | | 258 | | 1,019 | |
| Shoresmen..... | 301 | | 66 | | 623 | |
| Total..... | 774 | | 411 | | 2,289 | |
| INVESTMENT. | | | | | | |
| Vessels fishing: | | | | | | |
| Steam..... | 6 | \$73,050 | 2 | \$60,000 | 24 | \$328,213 |
| Tonnage..... | 952 | | 172 | | 2,240 | |
| Outfit..... | | 18,708 | | 12,660 | | 135,346 |
| Gasoline..... | 19 | 60,550 | 7 | 21,850 | 67 | 180,425 |
| Tonnage..... | 273 | | 83 | | 924 | |
| Outfit..... | | 25,325 | | 15,625 | | 94,690 |
| Sail..... | 3 | 1,200 | 2 | 2,100 | 24 | 12,495 |
| Tonnage..... | 33 | | 15 | | 183 | |
| Outfit..... | | 1,050 | | 1,870 | | 7,955 |
| Vessels transporting: | | | | | | |
| Steam..... | | | | | 2 | 13,200 |
| Tonnage..... | | | | | 111 | |
| Outfit..... | | | | | | 9,627 |
| Gasoline..... | 4 | 7,800 | | | 4 | 7,800 |
| Tonnage..... | 95 | | | | 95 | |
| Outfit..... | | 4,370 | | | | 4,370 |
| Barges..... | 2 | 4,000 | | | 2 | 4,000 |
| Tonnage..... | 316 | | | | 316 | |
| Outfit..... | | 1,900 | | | | 1,900 |
| Boats: | | | | | | |
| Sail, row, etc..... | 156 | 2,773 | 62 | 1,461 | 399 | 9,670 |
| Power..... | 61 | 14,215 | 163 | 88,061 | 364 | 136,881 |
| Apparatus, vessel fisheries: | | | | | | |
| Purse seines..... | | | 4 | 7,800 | 4 | 7,800 |
| Gill nets..... | | | 115 | 2,680 | 115 | 2,680 |
| Lines..... | | | | 555 | | 555 |
| Otter trawls..... | 1 | 30 | 6 | 350 | 14 | 680 |
| Harpoons..... | | | | 570 | | 600 |
| Lobster pots..... | 30 | 100 | | | 480 | 745 |
| Dredges..... | 83 | 3,030 | | | 372 | 8,437 |
| Apparatus, shore fisheries: | | | | | | |
| Seines..... | | | 4 | 1,105 | 54 | 4,893 |
| Gill nets..... | | | 28 | 3,465 | 204 | 13,910 |
| Pound nets..... | 2 | 577 | 31 | 5,600 | 42 | 9,112 |
| Fyke nets..... | 4 | 75 | 132 | 1,420 | 439 | 3,985 |
| Scoop nets..... | | | 4 | 20 | 7 | 35 |
| Lines..... | | 18 | | 40 | | 58 |
| Otter trawls..... | 10 | 361 | 33 | 1,643 | 53 | 2,394 |
| Harpoons..... | | | | 80 | | 80 |
| Lobster pots..... | 3,835 | 8,238 | 8,900 | 27,183 | 16,173 | 42,534 |
| Eel pots..... | 22 | 37 | 634 | 457 | 801 | 617 |
| Dredges..... | 4 | 36 | | | 55 | 395 |
| Tongs..... | 207 | 1,724 | 3 | 25 | 244 | 1,994 |
| Rakes..... | 44 | 251 | | | 61 | 367 |
| Hooks..... | 45 | 41 | | | 68 | 69 |
| Shovels..... | 13 | 13 | | | 13 | 13 |
| Spears..... | 28 | 34 | 2 | 5 | 30 | 39 |
| Shore and accessory property..... | | 147,065 | | 62,261 | | 498,699 |
| Cash capital..... | | 50,200 | | 19,300 | | 98,500 |
| Total..... | | 427,380 | | 338,126 | | 1,645,793 |
| PRODUCT. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Albacore..... | 540 | \$5 | 37,776 | \$2,502 | 177,150 | \$6,637 |
| Blue fish..... | 660 | 80 | 2,085 | 241 | 3,710 | 386 |
| Bonito..... | | | 6,120 | 912 | 6,120 | 912 |
| Bullheads..... | | | 1,067 | 77 | 1,492 | 100 |
| Butterfish..... | | | 18,760 | 2,604 | 18,810 | 2,607 |
| Carp..... | | | 9,778 | 1,140 | 40,141 | 4,922 |
| Cod..... | | | 96,136 | 9,603 | 96,136 | 9,603 |
| Croaker..... | | | 6,767 | 73 | 6,767 | 73 |
| Loos..... | 14,153 | 1,960 | 37,705 | 6,233 | 63,046 | 9,839 |
| Flounder..... | 99,455 | 4,801 | 1,980,441 | 77,232 | 2,340,181 | 91,962 |
| Flounder..... | | | 350 | 28 | 350 | 38 |
| Hake..... | 100 | 2 | 10,100 | 100 | 10,200 | 102 |
| Hakebut..... | | | 25,000 | 5,000 | 25,000 | 5,000 |
| Herring..... | | | 3,000 | 71 | 3,000 | 71 |
| Maquod..... | 7,460 | 1,572 | 83,989 | 9,418 | 91,389 | 10,990 |

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT
IN 1919, BY COUNTIES—Continued.

| Item. | New Haven. | | New London. | | Total. | |
|---------------------|------------|---------|-------------|----------|------------------------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| PRODUCTS—continued. | | | | | | |
| Menhaden..... | 102,350 | \$350 | 6,615,600 | \$91,827 | 6,736,564 | \$93,312 |
| Perch, yellow..... | | | 2,461 | 251 | 6,108 | 595 |
| Pickarel..... | | | 611 | 88 | 1,079 | 143 |
| Pollock..... | | | 10,135 | 717 | 10,135 | 717 |
| Scup..... | | | 1,980 | 202 | 1,980 | 202 |
| Sea bass..... | 210 | 60 | 3,345 | 468 | 3,555 | 528 |
| Shad..... | 327 | 83 | 98,088 | 18,618 | 463,203 | 86,637 |
| Skates..... | | | 400 | 10 | 400 | 10 |
| Smelt..... | | | 21,103 | 3,580 | 25,217 | 4,466 |
| Squeteague..... | 808 | 58 | 19,547 | 2,968 | 23,076 | 3,257 |
| Striped bass..... | 21 | 5 | 3,939 | 944 | 4,810 | 1,059 |
| Sturgeon..... | | | | | 25 | 5 |
| Suckers..... | | | 14,950 | 1,006 | 99,053 | 7,488 |
| Sunfish..... | | | | | 105 | 11 |
| Swordfish..... | | | 86,948 | 14,711 | 88,428 | 15,006 |
| Tautog..... | 500 | 50 | 20,633 | 1,957 | 21,942 | 2,068 |
| Tomeod..... | | | 455 | 37 | 455 | 37 |
| Tuna..... | | | 5,114 | 550 | 5,114 | 550 |
| Whiting..... | | | 9,317 | 175 | 9,317 | 175 |
| Lobsters..... | 163,674 | 45,633 | 423,895 | 96,547 | 740,848 | 189,157 |
| Squid..... | | | 3,612 | 258 | 3,612 | 258 |
| Clams: | | | | | | |
| Hard..... | 10,504 | 4,323 | | | ¹ 49,976 | 18,912 |
| Soft..... | 208,950 | 30,541 | | | ² 229,150 | 32,070 |
| Scallops..... | | | 38,400 | 13,717 | ³ 38,400 | 13,717 |
| Oysters: | | | | | | |
| Market— | | | | | | |
| Public..... | 106,708 | 15,210 | 7,000 | 3,000 | ⁴ 136,654 | 21,900 |
| Private..... | 2,250,857 | 212,830 | | | ⁵ 4,826,668 | 471,766 |
| Seed— | | | | | | |
| Public..... | 106,631 | 10,004 | | | ⁶ 740,516 | 68,349 |
| Private..... | 1,517,411 | 152,324 | | | ⁷ 6,493,865 | 525,001 |
| Total..... | 4,591,239 | 509,891 | 9,706,507 | 366,845 | 23,652,647 | 1,700,638 |

¹ 6,247 bushels.² 22,915 bushels.³ 6,400 bushels.⁴ 19,522 bushels.⁵ 689,524 bushels.⁶ 105,788 bushels.⁷ 927,695 bushels.

FISHERIES BY APPARATUS.

Dredges employed in the oyster fisheries of Connecticut in 1919 were the most productive form of apparatus. In the vessel fisheries dredges took 11,844,084 pounds, or 1,692,012 bushels, of oysters, valued at \$1,037,717, and in the shore fisheries dredges, tongs, rakes, and hoes took oysters to the amount of 353,619 pounds, or 50,517 bushels, valued at \$49,299, and clams to the amount of 279,126 pounds, or 29,162 bushels, valued at \$50,982. The catch with pots amounted to 768,078 pounds, valued at \$192,629, of which 740,848 pounds, valued at \$189,157, were lobsters. Otter trawls caught flounders, giant scallops, and hake to the amount of 2,359,221 pounds, valued at \$103,031. The catch with purse seines amounted to 6,625,240 pounds, valued at \$93,812, the principal species taken being menhaden to the amount of 6,608,400 pounds, valued at \$91,765. Gill nets, used principally in the taking of shad, yielded 443,551 pounds, valued at \$76,175. The quantity of shad taken with gill nets amounted to 374,823 pounds, or 86,567 in number, valued at \$69,201, of which 53,822 were roes and 32,745 were bucks. Various species were taken with lines, amounting to 201,763 pounds, valued at \$24,241; with pound nets, amounting to 379,371 pounds, valued at \$22,047; and with seines, amounting to 189,160 pounds, valued at \$21,680. All forms of apparatus employed in both the vessel and shore fisheries yielded a total of 23,652,647 pounds, valued at \$1,700,638.

The following tables give the products of the vessel and shore or boat fisheries in 1919, by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF CONNECTICUT IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

| Apparatus and species. | Fairfield. | | New Haven. | | New London. | | Total. | |
|-----------------------------|------------|---------|------------|---------|-------------|---------|------------|-----------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Purse seines: | | | | | | | | |
| Mackerel..... | | | | | 16,840 | \$2,047 | 16,840 | \$2,047 |
| Menhaden..... | | | | | 6,608,400 | 91,765 | 6,608,400 | 91,765 |
| Total..... | | | | | 6,625,240 | 93,812 | 6,625,240 | 93,812 |
| Gill nets: Mackerel..... | | | | | 41,688 | 4,310 | 41,688 | 4,310 |
| Lines: | | | | | | | | |
| Cod..... | | | | | 93,694 | 9,503 | 93,694 | 9,503 |
| Halibut..... | | | | | 25,000 | 5,000 | 25,000 | 5,000 |
| Pollock..... | | | | | 9,810 | 687 | 9,810 | 687 |
| Total..... | | | | | 128,504 | 15,190 | 128,504 | 15,190 |
| Dredges: Oysters— | | | | | | | | |
| Market— | | | | | | | | |
| Public..... | 1,400 | \$160 | 3,500 | \$410 | | | 4,900 | 770 |
| Private..... | 2,555,161 | 225,544 | 2,261,143 | 202,176 | | | 4,756,304 | 457,720 |
| Seed— | | | | | | | | |
| Public..... | 527,583 | 48,369 | 72,632 | 6,817 | | | 600,215 | 55,186 |
| Private..... | 4,965,254 | 371,717 | 1,517,411 | 152,324 | | | 6,482,665 | 524,041 |
| Total..... | 8,049,398 | 645,790 | 3,794,686 | 301,927 | | | 11,844,084 | 1,037,717 |
| Otter trawls: | | | | | | | | |
| Flounders..... | 45,605 | 2,527 | 3,330 | 200 | 439,841 | 14,943 | 488,776 | 17,670 |
| Hake..... | | | | | 10,000 | 100 | 10,000 | 100 |
| Scallops..... | | | | | 2,816 | 853 | 2,816 | 853 |
| Total..... | 45,605 | 2,527 | 3,330 | 200 | 452,657 | 15,896 | 501,592 | 18,623 |
| Lobster pots: Lobsters..... | 14,131 | 5,141 | 2,476 | 793 | | | 16,607 | 5,934 |
| Harpoons: Swordfish..... | 1,480 | 295 | | | 76,828 | 12,501 | 78,308 | 12,796 |
| Grand total..... | 8,110,614 | 653,753 | 3,800,192 | 392,920 | 7,324,917 | 141,709 | 19,236,023 | 1,188,382 |

YIELD OF SHORE FISHERIES OF CONNECTICUT IN 1919, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES AND GILL NETS.

| Apparatus and species. | Fairfield. | | Hartford. | | Middlesex. | | New London. | | Total. | |
|------------------------|------------|--------|-----------|---------|------------|--------|-------------|--------|---------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Seines: | | | | | | | | | | |
| Alewives..... | | | 30,484 | \$1,988 | 16,384 | \$277 | 800 | \$40 | 56,768 | \$2,305 |
| Bullhead..... | | | 60 | 6 | 300 | 14 | | | 360 | 20 |
| Carp..... | | | 9,373 | 1,381 | 12,512 | 1,460 | 6,810 | 806 | 28,695 | 3,647 |
| Eels..... | | | | | | | 4,440 | 801 | 4,440 | 801 |
| Perch, yellow..... | | | 530 | 44 | 299 | 27 | | | 829 | 71 |
| Pickerel..... | | | | | 109 | 12 | | | 109 | 12 |
| Shad..... | | | 18,873 | 4,595 | 26,407 | 4,666 | 5,088 | 1,219 | 50,368 | 10,480 |
| Smelt..... | 4,114 | \$886 | | | | | 293 | 50 | 4,407 | 936 |
| Striped bass..... | | | | | | | 660 | 151 | 660 | 151 |
| Suckers..... | | | 27,511 | 2,233 | 15,048 | 1,016 | | | 42,559 | 3,254 |
| Sunfish..... | | | | | 25 | 3 | | | 25 | 3 |
| Total..... | 4,114 | 886 | 95,831 | 10,252 | 71,184 | 7,475 | 18,031 | 3,067 | 189,100 | 21,680 |
| Gill nets: | | | | | | | | | | |
| Alewives..... | | | | | 11,446 | 385 | 9,297 | 1,572 | 20,743 | 1,957 |
| Bluefish..... | | | | | 925 | 92 | | | 925 | 92 |
| Carp..... | | | | | 31 | 3 | 2,968 | 394 | 2,999 | 337 |
| Eels..... | | | | | | | 94 | 9 | 94 | 9 |
| Menhaden..... | 300 | 25 | | | | | | | 300 | 25 |
| Shad..... | | | 15,465 | 3,876 | 268,428 | 48,362 | 90,930 | 16,933 | 374,823 | 69,201 |
| Squeteague..... | | | | | 1,104 | 111 | | | 1,104 | 111 |
| Striped bass..... | | | | | 850 | 110 | | | 850 | 110 |
| Sturgeon..... | | | | | 25 | 5 | | | 25 | 5 |
| Total..... | 300 | 25 | 15,465 | 3,876 | 282,809 | 49,098 | 103,289 | 18,848 | 401,863 | 71,847 |

YIELD OF SHORE FISHERIES OF CONNECTICUT IN 1919, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY POUND NETS, FYKE NETS, AND LINES.

| Apparatus and species. | Hartford. | | Middlesex. | | New Haven. | | New London. | | Total. | |
|------------------------|-----------|--------|------------|---------|------------|--------|-------------|--------|---------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Pound nets: | | | | | | | | | | |
| Alewives..... | | | 68,073 | \$1,405 | 500 | \$5 | 26,115 | \$808 | 94,688 | \$2,218 |
| Bluefish..... | | | 40 | 3 | | | 200 | 32 | 240 | 35 |
| Butterfish..... | | | 50 | 3 | | | 18,760 | 2,604 | 18,810 | 2,607 |
| Carp..... | | | 5,093 | 571 | | | | | 5,093 | 571 |
| Cusk..... | | | | | | | 6,767 | 73 | 6,767 | 73 |
| Eels..... | | | | | | | 2,150 | 300 | 2,150 | 300 |
| Flounders..... | | | 6,350 | 187 | | | 20,215 | 1,837 | 26,565 | 2,021 |
| Herring..... | | | | | | | 3,000 | 71 | 3,000 | 71 |
| Mackerel..... | | | | | | | 410 | 67 | 410 | 67 |
| Menhaden..... | | | 18,314 | 1,110 | 102,350 | 350 | 7,200 | 62 | 127,864 | 1,522 |
| Perch, yellow..... | | | 736 | 67 | | | 50 | 10 | 786 | 77 |
| Scup..... | | | | | | | 1,980 | 202 | 1,980 | 202 |
| Sea bass..... | | | | | 210 | 60 | | | 210 | 60 |
| Shad..... | | | 31,994 | 6,251 | 327 | 83 | 2,070 | 466 | 37,391 | 6,800 |
| Skates..... | | | | | | | 400 | 10 | 400 | 10 |
| Squeteague..... | | | 1,617 | 120 | | | 18,650 | 2,841 | 20,267 | 2,961 |
| Striped bass..... | | | | | | | 2,349 | 559 | 2,349 | 559 |
| Suckers..... | | | 6,069 | 384 | | | | | 6,069 | 384 |
| Tautog..... | | | 809 | 61 | 500 | 50 | 9,639 | 925 | 10,948 | 1,036 |
| Tomcod..... | | | | | | | 455 | 37 | 455 | 37 |
| Whiting..... | | | | | | | 9,317 | 175 | 9,317 | 175 |
| Squid..... | | | | | | | 3,612 | 258 | 3,612 | 258 |
| Total..... | | | 142,145 | 10,162 | 103,887 | 548 | 133,339 | 11,337 | 379,371 | 22,047 |
| Fyke nets: | | | | | | | | | | |
| Alewives..... | 677 | \$20 | 2,710 | 55 | | | 1,564 | 82 | 4,951 | 157 |
| Bullhead..... | | | 65 | 3 | | | 1,067 | 77 | 1,132 | 80 |
| Carp..... | 2,481 | 256 | 873 | 111 | | | | | 3,354 | 367 |
| Eels..... | 4,768 | 1,038 | 98 | 10 | | | 8,100 | 1,884 | 12,966 | 2,932 |
| Flounders..... | | | | | 495 | 28 | 5,740 | 325 | 6,235 | 353 |
| Hake..... | | | | | 100 | 2 | | | 100 | 2 |
| Perch, yellow..... | 1,904 | 191 | 178 | 15 | | | 2,411 | 241 | 4,493 | 447 |
| Pickarel..... | 128 | 20 | 231 | 23 | | | 611 | 88 | 970 | 131 |
| Squeteague..... | | | | | 803 | 58 | 111 | 14 | 919 | 72 |
| Striped bass..... | | | | | 21 | 5 | 210 | 39 | 231 | 44 |
| Suckers..... | 28,065 | 2,326 | 7,410 | 518 | | | 14,950 | 1,006 | 50,425 | 3,850 |
| Sunfish..... | 80 | 8 | | | | | | | 80 | 8 |
| Tautog..... | | | | | | | 390 | 33 | 390 | 33 |
| Total..... | 38,103 | 3,859 | 11,565 | 735 | 1,424 | 93 | 35,154 | 3,789 | 86,246 | 8,476 |
| Lines: | | | | | | | | | | |
| Bluefish..... | | | | | 660 | 80 | 1,885 | 179 | 2,545 | 259 |
| Bonito..... | | | | | | | 6,120 | 912 | 6,120 | 912 |
| Cod..... | | | | | | | 2,442 | 100 | 2,442 | 100 |
| Eels..... | | | | | 515 | 48 | 2,012 | 357 | 2,527 | 405 |
| Flounders..... | | | | | 2,450 | 216 | 3,110 | 155 | 5,560 | 371 |
| Haddock..... | | | | | | | 350 | 38 | 350 | 38 |
| Mackerel..... | | | | | 7,400 | 1,572 | 25,051 | 2,994 | 32,451 | 4,566 |
| Pollock..... | | | | | | | 325 | 30 | 325 | 30 |
| Sea bass..... | | | | | | | 3,345 | 468 | 3,345 | 468 |
| Smelt..... | | | | | | | 310 | 45 | 310 | 45 |
| Squeteague..... | | | | | | | 786 | 113 | 786 | 113 |
| Striped bass..... | | | | | | | 780 | 195 | 780 | 195 |
| Tautog..... | | | | | | | 10,604 | 999 | 10,604 | 999 |
| Tuna..... | | | | | | | 5,114 | 550 | 5,114 | 550 |
| Total..... | | | | | 11,025 | 1,916 | 62,234 | 7,135 | 73,259 | 9,051 |

BY OTTER TRAWLS, HARPOONS, SCOOP NETS, POTS, AND SPEARS.

| Apparatus and species. | Fairfield. | | Hartford. | | Middlesex. | |
|------------------------------|------------|---------|-----------|--------|------------|---------|
| | Pounds. | Value. | Pounds. | Value. | Pounds. | Value. |
| Otter trawls: Flounders..... | 33,500 | \$1,200 | | | 177,810 | \$6,015 |
| Scoop nets: Shad..... | | | 621 | \$156 | | |
| Pots: | | | | | | |
| Eels..... | | | | | 6,322 | 598 |
| Lobsters..... | 58,793 | 18,744 | | | 80,355 | 23,092 |
| Total..... | 58,793 | 18,744 | | | 86,677 | 23,690 |
| Grand total..... | 98,293 | 19,944 | 621 | 156 | 264,487 | 29,705 |

YIELD OF SHORE FISHERIES OF CONNECTICUT IN 1919, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY OTTER TRAWLS, HARPOONS, SCOOP NETS, POTS, AND SPEARS—Continued.

| Apparatus and species. | New Haven. | | New London. | | Total. | |
|------------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Otter trawls: | | | | | | |
| Flounders..... | 93,200 | \$4,357 | 1,511,535 | \$59,972 | 1,822,045 | \$71,544 |
| Scallops..... | | | 35,584 | 12,864 | 35,584 | 12,864 |
| Total..... | 93,200 | 4,357 | 1,547,119 | 72,836 | 1,857,629 | 84,408 |
| Harpoons: Swordfish.. | | | 10,120 | 2,210 | 10,120 | 2,210 |
| Scoop nets: | | | | | | |
| Shad..... | | | | | 621 | 156 |
| Smelt..... | | | 20,500 | 3,485 | 20,500 | 3,485 |
| Total..... | | | 20,500 | 3,485 | 21,121 | 3,641 |
| Pots: | | | | | | |
| Eels..... | 276 | 42 | 20,632 | 2,832 | 27,230 | 3,472 |
| Lobsters..... | 161,198 | 44,840 | 423,895 | 96,547 | 724,241 | 183,223 |
| Total..... | 161,474 | 44,882 | 444,527 | 99,379 | 751,471 | 186,695 |
| Spears: Eels..... | 13,362 | 1,870 | 277 | 50 | 13,639 | 1,920 |
| Grand total..... | 268,036 | 51,109 | 2,022,543 | 177,960 | 2,653,980 | 278,874 |

BY DREDGES, TONGS, RAKES, HOES, AND SHOVELS.

| Species. | Fairfield. | | Middlesex. | | New Haven. | | New London. | | Total. | |
|--------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> | <i>Pounds.</i> | <i>Value.</i> |
| Clams: | | | | | | | | | | |
| Hard..... | 39,472 | \$14,589 | | | 10,504 | \$4,323 | | | 49,976 | \$18,912 |
| Soft..... | 8,000 | 725 | 12,200 | \$804 | 208,950 | 30,541 | | | 229,150 | 32,070 |
| Oysters: | | | | | | | | | | |
| Market— | | | | | | | | | | |
| Public..... | 17,542 | 2,729 | 4,004 | 515 | 103,208 | 14,600 | 7,000 | \$3,000 | 131,754 | 21,130 |
| Private..... | 15,035 | 2,391 | 5,614 | 1,001 | 49,714 | 10,654 | | | 70,364 | 14,046 |
| Seed— | | | | | | | | | | |
| Public..... | 105,302 | 9,976 | | | 33,999 | 3,187 | | | 140,301 | 13,163 |
| Private..... | 11,260 | 960 | | | | | | | 11,260 | 960 |
| Total..... | 197,572 | 31,561 | 21,818 | 2,615 | 496,375 | 63,395 | 7,000 | 3,000 | 652,745 | 109,281 |

WHOLESALE FISHERY TRADE AND MENHADEN INDUSTRY.

In 1919 there were 25 establishments engaged in the wholesale fishery trade of Connecticut, employing 559 persons, to whom \$338,884 were paid in wages. The value of these establishments with their equipment, etc., was \$418,801 and the cash capital utilized amounted to \$81,500.

There were only two factories engaged in the reduction of menhaden to oil and scrap. The statistics of these plants have been included in the fishery industries table of Massachusetts.

ALASKA FISHERY AND FUR-SEAL INDUSTRIES IN 1920.¹

By **WARD T. BOWER**, *Agent, Alaska Service.*

CONTENTS.

| | Page. |
|--|-------|
| INTRODUCTION..... | 6 |
| Regular employees, Alaska service..... | 7 |
| FISHERY INDUSTRIES..... | 9 |
| Waters closed to commercial fishing..... | 9 |
| Stream marking..... | 12 |
| Stream watchmen..... | 12 |
| Fishery patrol..... | 13 |
| Bureau patrol boats..... | 13 |
| Naval and other public vessels..... | 14 |
| War Department regulations..... | 15 |
| Alaska fishery intelligence service..... | 17 |
| Inspection of canneries..... | 17 |
| Violations of fisheries laws and regulations..... | 18 |
| Territorial tax law upheld..... | 26 |
| Robbery of fish traps..... | 29 |
| Territorial fish commission..... | 30 |
| Territorial license tax..... | 30 |
| Destruction of predatory fishes in Bristol Bay region..... | 31 |
| Naknek section..... | 31 |
| Wood River section..... | 32 |
| Kvichak and Iliamna section..... | 34 |
| Summary..... | 36 |
| Recommendations..... | 37 |
| Afognak Reservation..... | 37 |
| Aleutian Islands Reservation..... | 39 |
| Annette Island Fishery Reserve..... | 39 |
| Copper River fishery..... | 40 |
| Yukon River fishery..... | 41 |
| Hatcheries..... | 42 |
| Extent of operations..... | 42 |
| Hatchery rebates..... | 43 |
| Hatchery operations..... | 43 |
| McDonald Lake..... | 43 |
| Afognak..... | 43 |
| Fortmann..... | 44 |
| Quadra..... | 44 |
| Juneau..... | 44 |
| General statistics of the fisheries in 1920..... | 44 |
| Salmon industry..... | 46 |
| Salmon catch and forms of gear..... | 47 |
| Salmon canning..... | 49 |
| Changes in canneries..... | 49 |
| New canneries..... | 49 |

¹ Appendix VI to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 909.

FISHERY INDUSTRIES—Continued.

Salmon industry—Continued.

Salmon canning—Continued.

Page.

Canneries not operated..... 49

Total canneries operated..... 50

Losses and disasters in the salmon-canning industry..... 52

Statistics..... 53

Mild curing of salmon..... 56

Salmon pickling..... 57

Salmon freezing..... 58

Fresh salmon..... 59

Dry salting of salmon..... 60

Drying and smoking of salmon..... 60

Salmon by-products..... 60

Halibut fishery..... 61

Statistical summary..... 61

Herring fishery..... 62

Statistical summary..... 62

Cod fishery..... 63

Vessel fishery..... 64

Shore stations..... 64

Statistical summary..... 65

Whale fishery..... 66

Shore stations..... 66

Statistical summary..... 66

Clam canning..... 67

Minor fisheries..... 68

Trout..... 68

Sablefish..... 68

Crabs..... 69

Shrimps..... 69

Miscellaneous fishery products..... 69

FUR-SEAL INDUSTRY..... 70

Pribilof Islands..... 70

General administrative work..... 70

Personnel..... 70

Purchase and transportation of supplies..... 71

Power schooner *Eider*..... 72

Departmental order regarding visiting of fur-seal rookeries..... 73

Construction work..... 73

Use of tractors..... 74

By-products plant..... 74

Improved sealing methods..... 75

Natives..... 76

Health conditions..... 76

Schools..... 77

Attendance at Salem Indian Training School, Chemawa, Oreg..... 78

Savings accounts..... 79

Payments for taking sealskins..... 79

Payments for taking fox skins..... 81

Census..... 81

Fur-seal herd..... 82

Quota for killing..... 82

Killings of seals..... 83

Age classes of seals..... 84

Branded seals..... 85

Census..... 86

Specimens for scientific purposes..... 86

Foxes..... 87

Trapping season of 1920-21..... 87

Methods employed in the management of the blue foxes on St. George Island, Alaska..... 87

Food..... 88

Trapping..... 89

Handling of skins..... 93

| | |
|---|-------|
| FUR-SEAL INDUSTRY—Continued. | |
| Pribilof Islands—Continued. | |
| Foxes—Continued. | |
| Methods employed, etc.—Continued. | Page. |
| Disposition of carcasses | 94 |
| Breeding reserve | 94 |
| Reindeer | 95 |
| Shipments of fur-seal and fox skins from Pribilof Islands in 1920 | 95 |
| Sales of fur-seal skins | 96 |
| Summary of fur-seal skins shipped to Funsten Bros. & Co. | 99 |
| Fur-seal skins on hand December 31, 1920 | 100 |
| Sale of fox skins postponed | 101 |
| Patrol of North Pacific Ocean and Bering Sea | 101 |
| Sealing privileges accorded aborigines | 103 |
| Japanese sealskins delivered to the United States | 103 |
| FUR-SEAL CENSUS, PRIBILOF ISLANDS, 1920 | 104 |
| Pups | 104 |
| Cows | 108 |
| Loss of cows on the islands | 108 |
| Loss of cows at sea | 110 |
| Branded animals | 110 |
| Bulls | 113 |
| Harem and idle bulls | 113 |
| Average harem | 115 |
| Losses of bulls and young males | 116 |
| Complete census of fur seals as of August 10, 1920 | 120 |
| NATURAL-HISTORY RECORDS OF PRIBILOF ISLANDS | 122 |
| Bibliography | 123 |
| Fur seals | 123 |
| Foxes | 125 |
| Birds | 125 |
| Miscellaneous | 126 |
| INVESTIGATION OF THE SALMON FISHERIES OF THE YUKON RIVER | 128 |
| Outline of proposed investigations | 128 |
| Itinerary | 128 |
| Important species of salmon with data concerning runs | 129 |
| Red or sockeye salmon | 129 |
| Humpback salmon | 130 |
| Coho salmon | 130 |
| King salmon | 131 |
| Chum or dog salmon | 131 |
| Yukon delta, its principal channels, and routes mainly followed by salmon | 138 |
| Commercial fishery operations in Yukon delta in 1920 | 140 |
| Supply of dried salmon prepared on Yukon River in 1920 | 143 |
| Comparison of 1920 with 1919 | 147 |
| To what extent was Yukon cannery responsible for 1919 shortage? | 148 |
| Effect of cannery in 1920 | 150 |
| General discussion and recommendations | 151 |

INTRODUCTION.

The Bureau's work in Alaska was conducted along the usual lines in the calendar year 1920. Shortage of funds handicapped the work of the fisheries service early in the season before the new appropriations became available July 1. A force of temporary stream watchmen was again made use of during the active fishing season, working under the direction of the Bureau's permanent employees in the patrol of the fishing grounds for the enforcement of the laws and regulations. Vessels of the subchaser type and one mine sweeper were stationed in southeastern Alaska to aid in law enforcement.

A further study was made of the condition of the salmon fishery of the Yukon River, and an expedition was sent into the Bristol Bay region which did excellent work in the destruction of predatory fishes and gathered certain information in regard to the spawning beds and runs of red salmon in streams tributary to Bristol Bay. Five hearings were held by the Bureau at Cordova and Seattle late in the year, and further restrictions imposed on commercial fishing for salmon in Alaska.

Private salmon hatcheries were inspected as usual, and work was continued by the Bureau at its hatcheries on McDonald Lake and at Afognak. Excellent progress was made in the marking of the mouths of salmon streams, one vessel in the southeastern district being almost exclusively engaged in the work. Detailed statistics of the fishery industry of Alaska were collected and compiled as heretofore.

In accordance with the recommendation repeatedly made by the Secretary of Commerce and the Commissioner of Fisheries, the Department of Commerce has been relieved of jurisdiction over certain minor fur-bearing animals in Alaska. The act of May 31, 1920, contained a section placing the land fur-bearing animals of Alaska under the control of the Bureau of Biological Survey, of the Department of Agriculture, and transferred to the Department of Commerce jurisdiction over walruses and sea lions. The Department of Commerce retains jurisdiction over the fur seals and sea otters, and over the blue fox herds of the Pribilof Islands. The Bureau's files and all matters pertaining to the land fur-bearing animals, including the leasing of islands for fur-farming, were promptly delivered to the Bureau of Biological Survey, which assumed jurisdiction upon the approval of the act. This report, therefore, does not contain a section dealing with the protection of the so-called minor fur-bearing animals of Alaska. Employees of this Bureau in Alaska have co-operated with representatives of the Bureau of Biological Survey whenever possible in the establishment of their work.

The Bureau's activities in connection with the taking of fur-seal skins and administration of the natives' affairs on the Pribilof Islands were carried on in the usual manner. The total take of sealskins in the calendar year 1920 was 26,648, having an estimated value of about \$1,000,000. The take of blue fox skins on the Pribilofs in the winter of 1920-21 was the largest for nearly 30 years, totaling 1,125 blues and 14 whites, with an estimated value of about \$100,000.

Transportation of necessary food, fuel, and supplies for the natives and white employees on the Pribilof Islands, together with return of products, was afforded through the courtesy of the Navy Department and the Coast Guard.

Two sales at public auction of sealskins taken on the Pribilof Islands were held at St. Louis in 1920 by the selling agents of the Bureau. The sale of fox skins was postponed because of low prices, but was held early in 1921.

The author of this report is greatly indebted to Assistant Agent E. M. Ball for compilation of statistics of the fisheries and preparation of accompanying text. Acknowledgment is also made to C. E. Crompton for assistance in the preparation of statistics and text in regard to the fur-seal industry.

REGULAR EMPLOYEES, ALASKA SERVICE.

During the year 1920 the following regular employees have been identified with the Alaska service of the Bureau:

REGULAR EMPLOYEES IDENTIFIED WITH THE ALASKA SERVICE IN 1920.

| Name. | Position. | Headquarters or chief place of duty. |
|----------------------------|----------------------------------|--|
| Ward T. Bower..... | Chief agent..... | Washington, D. C. |
| Edward M. Ball..... | Assistant agent..... | Juneau. |
| Harry J. Christoffers..... |do..... | Seattle. |
| Calvin F. Townsend..... | Inspector..... | Fairbanks. |
| Shirley A. Baker..... | Assistant agent..... | Cordova. |
| Lemuel G. Wingard..... |do..... | Naknek. (Promoted Oct. 1, 1920, from warden.) |
| A. H. Proctor..... | Superintendent..... | St. Paul Island. (Promoted July 1, 1920, from agent and caretaker, St. Paul Island.) |
| Charles E. Crompton..... | Agent and caretaker..... | St. George Island. |
| Henry D. Aller..... |do..... | St. Paul Island. (Promoted July 1, 1920, from storekeeper, St. Paul Island.) |
| G. Dallas Hanna..... | Storekeeper..... | St. Paul Island. (Resigned Jan. 15, 1920.) |
| Edward C. Johnston..... |do..... | St. George Island. (Promoted Apr. 16, 1920, from school-teacher.) |
| Henry C. Scudder..... |do..... | St. Paul Island. (Resigned as warden Apr. 23, 1920. Reinstated, assistant agent, July 1, 1920. Promoted Oct. 1, 1920.) |
| John J. Riehnstein..... | Physician..... | St. Paul Island. (Resigned June 30, 1920.) |
| Henry H. Stromberger..... |do..... | St. Paul Island. (Reinstated July 1, 1920. Resigned Aug. 4, 1920.) |
| W. C. Huyier..... |do..... | St. Paul Island. (Appointed Oct. 5, 1920. Resigned Nov. 18, 1920.) |
| George B. Bowlby..... |do..... | St. Paul Island. (Appointed Nov. 19, 1920.) |
| William M. Murphy..... |do..... | St. George Island. |
| Herschel Silverstone..... | Assistant to agent..... | St. Paul Island. (Resigned Sept. 30, 1920.) |
| Henry Mygatt..... |do..... | St. Paul Island. (Appointed Oct. 1, 1920.) |
| George Haley..... | School-teacher..... | St. Paul Island. (Resigned July 19, 1920.) |
| Lois L. Proctor..... |do..... | St. Paul Island. |
| Richard Culbertson..... |do..... | St. Paul Island. (Appointed July 20, 1920.) |
| Carl E. Fletcher..... |do..... | St. George Island. (Appointed May 29, 1920. Resigned Oct. 9, 1920.) |
| John M. Orchard..... |do..... | St. George Island. (Appointed Oct. 12, 1920.) |
| Michael J. O'Connor..... | Warden..... | Juneau. |
| Fred H. Gray..... |do..... | Wrangell. |
| Philip R. Hough..... |do..... | Juneau. (Resigned June 30, 1920.) |
| Joseph N. Braun..... |do..... | Ikatan. (Appointed May 1, 1920.) |
| William E. Baumann..... |do..... | Afogmak. (Appointed July 20, 1920.) |
| Chauncey C. Combs..... |do..... | Haines. (Appointed July 26, 1920. Resigned Sept. 30, 1920.) |
| James K. Nevill..... |do..... | Wrangell. (Appointed Aug. 1, 1920.) |
| Arthur L. Mellick..... | Master power vessel Eider..... | Unalaska. |
| Edwin Hofstad..... | Master steamer Osprey..... | Wrangell. |
| Jesse L. Nevill..... | Master patrol vessel Auklet..... | Do. |
| George G. Naud..... | Master patrol vessel Murro..... | Juneau. |
| Albert K. Brown..... | Clerk..... | Washington, D. C. |
| Mary S. Haines..... |do..... | Do. |
| William P. Rasin..... |do..... | Do. |
| Marguerite McBride..... |do..... | Washington, D. C. (Transferred to Coast and Geodetic Survey, Feb. 3, 1920.) |
| E. Elaine Bell..... |do..... | Seattle. |
| Gladys M. Garnlen..... |do..... | Seattle. (Resigned Mar. 6, 1920. Reinstated June 8, 1920.) |

REGULAR EMPLOYEES AT GOVERNMENT HATCHERIES IN ALASKA IN 1920.

| Location and name. | Position. |
|----------------------------|--|
| Afognak: | |
| Edwin Wentworth..... | Superintendent. |
| Harry J. Heuver..... | Foreman. |
| Russel Noyes..... | Fish-culturist. (Resigned June 30, 1920.) |
| Fred R. Lucas..... | Fish-culturist. |
| Thomas H. Morton..... | Fish-culturist. (Promoted Mar. 16, 1920 from apprentice fish-culturist at Afognak to fish-culturist at McDonald Lake. Transferred Sept. 16, 1920, to Afognak.) |
| Alfred Nelson..... | Apprentice fish-culturist. |
| Nicolai Boskofsky..... | Apprentice fish-culturist. (Appointed Oct. 6, 1920.) |
| Mildred I. Morton..... | Apprentice fish-culturist. (Appointed Nov. 4, 1920. Resigned Dec. 31, 1920.) |
| F. J. Stewart..... | Cook. (Resigned Dec. 31, 1920.) |
| McDonald Lake: | |
| C. H. Van Atta..... | Superintendent. |
| Calvin D. Ryan..... | Foreman. |
| William L. Stiles, Jr..... | Fish-culturist. (Transferred Mar. 1, 1920, to Leadville, Colo.) |
| Thomas H. Morton..... | Fish-culturist. (Promoted Mar. 16, 1920, from apprentice fish-culturist, Afognak. Transferred Sept. 16, 1920, to fish-culturist, Afognak.) |
| Albert L. Carlton..... | Fish-culturist. |
| Everett V. Campbell..... | Apprentice fish-culturist. (Resigned Apr. 30, 1920.) |
| Lawrence T. Hopkinson..... | Apprentice fish-culturist. (Appointed June 5, 1920. Transferred Sept. 1, 1920, to statistical agent, Washington, D. C.) |
| Clarence Houts..... | Apprentice fish-culturist. (Resigned Aug. 14, 1920.) |
| Anton Hougén..... | Apprentice fish-culturist. (Appointed Nov. 1, 1920.) |
| Barney Sevisen..... | Do. |
| Casper Udstrand..... | Apprentice fish-culturist. (Appointed Nov. 6, 1920.) |
| Stella A. Campbell..... | Cook. (Resigned Apr. 30, 1920.) |
| John P. Mobley..... | Cook. (Appointed May 1, 1920.) |

FISHERY INDUSTRIES.

As in corresponding reports for previous years, the Territory of Alaska is here considered in the three coastal geographic sections generally recognized, as follows: Southeast Alaska, embracing all that narrow strip of mainland and the numerous adjacent islands from Portland Canal northwestward to and including Yakutat Bay; central Alaska, the region on the Pacific from Yakutat Bay westward, including Prince William Sound, Cook Inlet, and the southern coast of Alaska Peninsula, to Unimak Pass; and western Alaska, the north shore of the Alaska Peninsula, including the Aleutian Islands and Bristol Bay and the Kuskokwim and Yukon Rivers.

Detailed reports and statistical tables dealing with the various fishery industries are presented herewith, and there are also given the important features of certain subjects which were the objects of special investigation or inquiry.

WATERS CLOSED TO COMMERCIAL FISHING.

Section 6 of the act approved June 26, 1906, for the protection and regulation of the fisheries of Alaska, is as follows:

SEC. 6. That the Secretary of Commerce may, in his discretion, set aside any streams or lakes as preserves for spawning grounds, in which fishing may be limited or entirely prohibited; and when, in his judgment, the results of fishing operations in any stream, or off the mouth thereof, indicate that the number of salmon taken is larger than the natural production of salmon in such stream, he is authorized to establish close seasons or to limit or prohibit fishing entirely for one year or more within such stream or within five hundred yards of the mouth thereof, so as to permit salmon to increase: *Provided, however,* That such power shall be exercised only after all persons interested shall be given a hearing, of which due notice must be given by publication; and where the interested parties are known to the Department they shall be personally notified by a notice mailed not less than thirty days previous to such hearing. No order made under this section shall be effective before the next calendar year after same is made: *And provided further,* That such limitations and prohibitions shall not apply to those engaged in catching salmon who keep such streams fully stocked with salmon by artificial propagation.

Pursuant to the provisions of this section, action was taken in 1920 in regard to waters of southeastern Alaska; waters between Cape Spencer and Cape Newenham, including Bering and Copper Rivers, Kuskokwim River, and Yukon River.

Under date of May 22, 1920, announcement was made of a hearing to be held to consider the necessity or desirability of making changes in the regulations in regard to the Yukon River. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce amend the order of December 14, 1918, limiting or prohibiting fishing for salmon in the Yukon River, Alaska, its tributary waters, and the waters of its delta, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that a hearing, for the purpose of eliciting information as to what,

if any, changes in the present Yukon River regulations are necessary or desirable, will be held at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on November 23, 1920, at 10 o'clock a. m., at which time and place all interested persons will be heard. All persons having pertinent information are particularly invited to be present and to impart such information.

Under date of May 25, 1920, announcement was made of a hearing to be held in respect to fishing in the Kuskokwim River. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce limit or prohibit fishing for salmon or other fishing in the prosecution of which salmon are taken or injured, in the Kuskokwim River, Alaska, its tributary waters, and within the area 500 yards outside the mouth of that river, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that a hearing to determine the advisability of limiting or prohibiting fishery operations in the waters in question will be held at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on November 30, 1920, at 10 o'clock a. m., at which time and place all interested persons will be heard. All persons having pertinent information are particularly invited to be present and to impart such information.

Under date of August 18, 1920, announcement was made of hearings to consider the necessity or desirability of changing the regulations regarding fishing in Copper River waters. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce amend the order of December 20, 1918, limiting or prohibiting fishing in the Copper River, Alaska, and its delta and all tributary waters, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that hearings for the purpose of eliciting information as to what, if any, changes in the present Copper River regulations are necessary or desirable will be held at Cordova, Alaska, on October 5, 1920, at 10 o'clock a. m., and at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on November 18, 1920, at 10 o'clock a. m., respectively, at which all interested persons will be heard. All persons having pertinent information are particularly invited to be present and to impart such information.

Under date of October 30, 1920, announcement was made of a hearing to be held in respect to amending the order of November 30, 1917, in regard to fishing in Bering River. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce amend the order of November 30, 1917, the provisions of which are continued in the order of December 23, 1919, prohibiting commercial fishing operations in Bering River and its tributary waters, including Bering Lake, above a line extending at right angles across Bering River from a point approximately 800 feet northwesterly from the mouth of Gandil River, Alaska, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that a hearing to determine the advisability of further limiting or prohibiting fishing operations in Bering River and its tributary waters, including Bering Lake, will be held at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on December 3, 1920, at 10 o'clock a. m., at which time and place all persons interested will be heard.

Following the hearings on October 5, November 18, 23, and 30, and December 3, the Department, under date of December 18, 1920, promulgated the following order:

Hearings having been given, after due notice in accordance with law, for the purpose of determining the advisability of limiting or prohibiting fishing in

certain waters in Alaska, and to amend or modify certain existing regulations, and all persons having had full opportunity to be heard, it is hereby ordered, by virtue of the authority vested in me by section 6 of "An act for the protection and regulation of the fisheries of Alaska," approved June 26, 1906, that until further notice all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in all hereinafter-described waters of Alaska be and is hereby made subject to the following limitations and prohibitions in addition to the general restrictions already applicable by virtue of existing laws and regulations.

1. Waters east of the longitude of Cape Spencer:

(a) All fishing is prohibited in all salmon streams and their tributaries and lakes.

(b) All fishing, except with purse seines and drift gill nets, is prohibited within 500 yards of the mouths of all salmon streams.

(c) All fishing with purse seines and drift gill nets is prohibited within 200 yards of the mouths of all salmon streams, and all fishing with purse seines and drift gill nets as well as with all other apparatus is prohibited within 500 yards of the mouths of Chilkat River, Chilkoot River, Anan Creek, Hetta Creek, Sockeye Creek, and Naha Stream.

2. All fishing is prohibited in all salmon streams, their tributaries and lakes, and within 500 yards of the mouths of such streams, flowing into the Pacific Ocean or Bering Sea between Cape Spencer and Cape Newenham, except as follows:

(a) Fishing is permitted in Copper River and its tributaries in accordance with the terms of the order promulgated December 20, 1918, which order is continued in full force until September 1, 1921, upon which date said order of December 20, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Copper River, its tributaries and lakes, and within 500 yards of each mouth of the Copper River, is prohibited.

(b) Fishing is permitted at Karluk beyond the zone 100 yards outside the mouth of Karluk River where it breaks through Karluk Spit into Shelikof Strait.

(c) Fishing is permitted in Ugashik River below a line extending at right angles across the Ugashik 500 yards below the mouth of King Salmon River.

3. On and after September 1, 1921, all fishing is prohibited in the Kuskokwim River, its tributaries and lakes, and within 500 yards of the mouth of the Kuskokwim for other than local use in Alaska.

4. Fishing is permitted in the Yukon River and its tributaries in accordance with the terms of the order promulgated December 14, 1918, which order is continued in full force until September 1, 1921, on which date said order of December 14, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Yukon River, its tributaries and lakes, and within 500 yards of each mouth of the Yukon, is prohibited for other than local use in Alaska.

5. The driving of salmon downstream and the causing of salmon to go outside the protected area at the mouth of any salmon stream are expressly prohibited.

6. This order does not apply to persons taking salmon with rod, hand line, or spear for their personal or family use and not for sale or barter.

7. The waters of the Afognak Reservation are covered by presidential proclamation of December 24, 1892, and the regulations promulgated by authority thereof are not modified or affected by this order but remain in full force.

8. All previous orders of the Secretary of Commerce imposing limitations or prohibitions upon fishing in the waters covered by this order, except as hereinbefore indicated, are hereby superseded.

9. This order becomes effective January 1, 1921.

Limitations and prohibitions upon fishing are applicable in the waters of the Yukon and Copper Rivers by virtue of previous orders of the Secretary of Commerce. Limitations have been placed upon fishing by Executive order or proclamation in the following additional waters: Afognak Reservation, Aleutian Islands Reservation, Yes Bay and Stream, and the Annette Island Fishery Reserve.

STREAM MARKING.

In order to make more effective the closing order of December 23, 1919, and to serve as a helpful guide to the fishermen, it was considered advisable to indicate by appropriate notices at suitable places on shore the protected waters off the mouth of each salmon stream in which fishing is prohibited. Though these notices in themselves could not prevent unlawful encroachments on the streams, they would serve as guides to those instinctively law-abiding and as warning to those having no respect for the fishery laws and regulations. Thus no one could plead in extenuation of a violation of the regulations that there were no visible means defining the bounds wherein operations would be illegal.

The placing of markers at the mouths of streams is therefore intended to be helpful to the fishermen in enabling them to locate the outer boundary of the protected area of each stream, and at the same time the markers serve the further purpose of making more certain to those engaged in the enforcement of the law and regulations that encroachments upon prohibited waters are not accidental.

The procedure generally followed in southeast Alaska in locating markers has been to define arbitrarily the mouths of streams at the line of mean low tide, unless physical conditions rendered such action impracticable. This is the case at some streams where considerable areas of silt have been deposited, which at low tide are exposed as comparatively extensive mud flats. Owing to the varied conditions encountered, no inflexible rule could be laid down for the determination of stream mouths, but as far as practicable the mouth of each stream was to be fixed at the line of mean low tide. Where this could not be done, authority was given to mark the mouths of such streams at the line of mean high tide.

Gratifying progress was made in the work of marking stream mouths in southeast Alaska. Signboards were erected at 189 streams. Of that number the mainland is credited with 21 streams, Chichagof Island with 60, Yakobi Island 2, Baranof Island 18, Admiralty Island 28, Kupreanof Island 5, Zarembo Island 1, Wrangell Island 2, Etolin Island 5, Mitkof Island 1, Kosciusko Island 6, and Prince of Wales Island 40. There are several hundred more salmon streams in southeast Alaska which have not been marked, but which will be given attention as funds may be available for such work.

In central Alaska markers were placed in 1920 at Eyak River, Mountain Slough, and Glacier River, all of which are streams of the delta of the Copper River, the several other outlets of the Copper having been marked in 1919. The Karluk River was also marked in 1920.

The salmon streams in western Alaska are comparatively large and few in number. Of those tributary to Bristol Bay seven were marked in 1920. They are as follows: Nushagak, Snake, Igushik, Kvichak, Naknek, Egagik, and Ugashik Rivers. The mouth of the Yukon River was marked in 1919.

STREAM WATCHMEN.

No more important work than the watching of salmon streams engages the attention of the Alaska service. The preservation of the

salmon runs may depend largely upon the degree of protection afforded in this manner. for experience has shown beyond doubt that most satisfactory results are thus obtained. The duty of stream watchmen is to prevent unlawful fishing in the streams where they are stationed and within the proscribed area off the mouths thereof.

In 1920 six men were employed as stream watchmen, of whom Fred W. Dost, Eric N. Aldrich, Earl C. Nelson, and John F. Ross were assigned to the southeastern district. The other two, Kenneth C. Cole and John J. Folstad, were stationed at Abercrombie and Karluk, respectively. By consent of the governor of Alaska, Joseph A. Bourke, a Territorial officer, was detailed to fishery work in the Prince William Sound region during the fishing season.

Three other men, Chauncey C. Combs, James K. Nevill, and William E. Baumann, began work in July as stream watchmen, but they were soon appointed permanent wardens in the Alaska fisheries service, and are therefore not to be counted in this category. The regular force of the service, including these three wardens, numbered 11 men, which, with the 6 stream watchmen and the 1 special assistant previously referred to, constituted a service of 18 men actively engaged in the protection of the fisheries of Alaska. In addition there were, of course, the men engaged in operating the several vessels used in protective work.

FISHERY PATROL.

BUREAU PATROL BOATS.

Five boats, owned by the Bureau, were used in patrolling the fishing grounds of Alaska in 1920. Three of them, the steamer *Osprey* and the power boats *Auklet* and *Murre*, operated in southeastern Alaska, while the other two, the *Swan* and *Tern*, were used on the Yukon River and tributaries, cruising together during much of the season. In addition the launch *Dicie* and the power boats *Anthoette* and *Try It* were chartered in July, August, and September for patrol service in the Juneau district. The launch *Prospector* was chartered in June and July for similar service on Prince William Sound and the Copper River flats.

The *Osprey* was transferred from the central district to southeastern Alaska in July, where it was used almost entirely in the work of marking the mouths of salmon streams. While being beached near Cordova, preparatory to having her hull cleaned and copper painted, the *Osprey* settled in the gravel and turned over on May 25, falling away from the shore at low water. The boat did not right itself on the flood tide, but filled with water and remained in this partly submerged condition for about a week until assistance was rendered by the Coast Guard cutter *Algonquin*, then in the vicinity. The following extract from a report by the Commodore Commandant of the Coast Guard describes the circumstances attending the salvage of the *Osprey*:

On May 30, while on her way to Latouche, the *Algonquin* received a dispatch from the headquarters of the Coast Guard at Washington, stating that the Bureau of Fisheries had requested her assistance in salvaging the steamer *Osprey*, ashore at Cordova. The cutter immediately headed for the stranded vessel and found her in Orca Inlet, 5 miles north of Cordova. She was lying

on her side, full of water. It was decided that a barge or scow was necessary to float the vessel, so the *Algonquin* proceeded to Cordova in search of one. A suitable scow, belonging to the Bering River Coal Co., was obtained, brought to the steamer *Osprey*, and hauled alongside her. On June 3 the *Osprey* was righted, floated, and made fast to a dolphin. The water was then bailed out of her.

In April the *Murre* was seriously damaged by striking a rock in Keku Strait while engaged on census work for the Bureau of Education. She was towed to Wrangell by the *Auklet* and repaired at a cost of \$1,623.87.

The following statement shows the mileage made by the patrol boats owned by the Bureau in their cruises of 1920: *Auklet*, 7,616; *Murre*, 6,635; *Osprey*, 3,793; *Swan*, 3,067; *Tern*, 2,367; total mileage, 23,478. In addition to the foregoing, extensive mileage was made by chartered patrol boats, especially the *Dixie*.

NAVAL AND OTHER PUBLIC VESSELS.

In March, 1920, a rather elaborate program was arranged between the Governor of Alaska and the Navy Department, Treasury Department, and the Department of Commerce, whereby certain vessels under the direction of each department were to participate in fishery patrol work in Alaska. The original order as approved by the heads of the three departments designated the following vessels to constitute a fleet for the protection of the fisheries of the Territory:

Naval vessels: *Eagle 57*, submarine chaser No. 294, and submarine chaser No. 309. (Subchaser No. 310 was detailed instead of No. 309.)

Coast Guard vessels: *Bothwell*, *Algonquin*, *Bear*, *Earp*, and *Unalga*.

Coast and Geodetic Survey vessels: *Explorer*, *Lydonia*, *Surveyor*, and *Wenonah*.

Eagle 57 and two subchasers, No. 294 and No. 310, were in Alaska during the summer months. The chasers reached Alaska in May and remained until the end of the fishing season. Subchaser No. 294, while commanded by Lieut. Thompson, United States Navy, made an energetic patrol of the district south of Petersburg, and did much to suppress trap robberies and illegal fishing generally. Subchaser No. 310 was similarly engaged in the district north of Petersburg, though much less actively. *Eagle 57* struck a reef at Gambier Bay July 3, en route from Bremerton to Juneau, and lost her propeller. On July 4 the vessel was towed to Juneau by the *Explorer* and several weeks later was towed to the Puget Sound Navy Yard by a naval tug. Thus *Eagle 57* performed no service in the interest of the fisheries of Alaska and was replaced on August 1 by the mine sweeper *Swallow*.

The commanding officer aboard each of these naval vessels was authorized by the Secretary of Commerce, under date of April 23, 1920, to make searches, arrests, and seizures in accordance with the provisions of the Alaska alien fisheries act of June 14, 1906. They, or other officers of the Navy assigned to this patrol, were also commissioned as deputy United States marshals, and at least one officer was appointed a United States commissioner.

The vessels of the Coast Guard were primarily in Alaskan waters to carry on the Bering Sea patrol for the protection of the fur-seal

herds annually resorting to the Pribilof Islands. A statement regarding this patrol appears in the fur-seal section of this report.

The vessels of the Coast and Geodetic Survey were engaged in the vitally important work of that service in different coastal districts of Alaska and therefore could not be expected to have opportunities to do much for the fisheries.

WAR DEPARTMENT REGULATIONS.

Early in 1920 a rather general protest was registered before the Chief of Engineers of the War Department by various interests in Alaska against the location of floating fish traps in offshore positions, it being contended that such traps were a menace to navigation. After considerable inquiry into the matter, the Acting Chief of Engineers issued, on April 22, 1920, a temporary order for the regulation of floating traps, as follows:

During the calendar year 1920 no floating pound net or fish trap in the navigable waters of Alaska shall exceed 2,400 feet in length over all nor be constructed and operated in more than 100 feet depth of water at the outer end of the net or trap at mean high tide according to the United States tide tables; with the exception that a floating pound net or fish trap may be constructed and operated in a greater depth of water, provided the extension, measured from the shore line, at mean high-tide line, does not exceed 1,000 feet over all.

At the same time announcement was made that public hearings would be held during the year to determine the advisability of continuing or modifying the order. Accordingly two hearings were held in 1920—one at Juneau on September 14 and the other at Seattle on November 19—as a result of which the War Department continued without modification the order of April 22. On January 5, 1921, new regulations were issued prescribing the conditions under which fishery operators may construct and maintain fish traps in the navigable waters of Alaska. The regulations are as follows:

WAR DEPARTMENT, OFFICE OF THE CHIEF OF ENGINEERS, *Washington, January 5, 1921.*

NOTE.—It is to be understood that this authority does not give any property rights either in real estate or material, or any exclusive privileges; and that it does not authorize any injury to private property or invasion of private rights, or any infringement of Federal, Territorial, or local laws or regulations, nor does it obviate the necessity of obtaining Territorial assent to the work authorized. It merely expresses the assent of the Federal Government so far as concerns the public rights of navigation. (See *Cummings v. Chicago*, 188 U. S., 410.)

To whom it may concern:

The attention of those fishing in the waters of the coast of the Territory of Alaska, and in the navigable waters tributary thereto, is called to the provisions of section 10 of the river and harbor act of March 3, 1899, as follows:

"SEC. 10. That the creation of any obstruction not affirmatively authorized by Congress to the navigable capacity of any of the waters of the United States is hereby prohibited; and it shall not be lawful to build or commence the building of any * * * weir * * * or other structure in any * * * navigable river or other waters of the United States, outside established harbor lines, or where no harbor lines have been established, except on plans recommended by the Chief of Engineers and authorized by the Secretary of War."

In accordance with the above provision of law, and until further notice, all fishermen who desire to operate in the waters above described, and under conditions stated as follows, but not otherwise, and whose written applications may receive the approval of the district engineer of the engineer department at large, in charge of the locality, are hereby authorized by the Secretary of War to construct and maintain fish weirs, traps, or pounds erected in the usual manner as heretofore, subject to the following conditions:

CONDITIONS.

1. All persons desiring to erect and maintain fish weirs, traps, or pounds under this authority shall make application to the District Engineer, United States Engineer Office, Seattle, Wash., giving their names, their addresses, the proposed location of their weir, trap, or pound, and evidence that the proper license has been granted by the Territory of Alaska.

2. That no floating fish trap shall exceed 2,400 feet in length over all, nor be constructed and operated in more than 100 feet depth of water at the outer end of the trap at mean high tide, according to the United States tide tables, with the exception that a floating trap may be constructed and operated in a greater depth of water, provided the extension measured from the shore line at mean high tide does not exceed 1,000 feet over all.

3. That all the apparatus used and the work herein authorized shall be subject to the supervision and approval of the aforesaid district engineer, who may temporarily suspend the work at any time if, in his judgment, the interests of navigation so require.

4. That no weir, trap, or pound shall be located or built in such place or manner as to unreasonably obstruct or interfere with navigation.

5. That on the outer end of the weir, trap, or pound the permittee or owner shall maintain a sign inscribed with the license number in numerals not less than 6 inches in height, capable of being readily read from passing vessels, and failure to keep such sign conspicuously displayed shall be sufficient reason for the cancellation of this authority and for prosecution as provided in the next paragraph. All renewals of the Territorial license shall be reported to the aforesaid district engineer when they occur, together with the Territorial license number. All changes of ownership shall also be reported to him immediately, and the permit shall be returned to him for proper notation thereon of such changes.

6. That upon the abandonment of the location or upon ceasing to use any weir, trap, or pound, as hereby authorized, the permit and the map or maps attached thereto shall be immediately returned to the aforesaid district engineer, with notice of the abandonment, and the owner shall immediately remove the structure at his own expense, including all piling, stakes, etc., to the satisfaction of the aforesaid district engineer. Failure to so remove the same shall be considered good ground for prosecution of the permittee or owner for maintaining an illegal structure endangering navigation, as set forth in sections 10 and 12 of the river and harbor act of March 3, 1899: *Provided*, That if the use of said structure is suspended temporarily it may be maintained in whole or in part if the license number is conspicuously displayed and the trap is properly lighted or otherwise marked, as may be necessary to prevent unreasonable obstruction to navigation. Any fish weir, trap, or pound allowed to go into a condition of disrepair so that it can not be readily seen, or on which the license number is not conspicuously displayed, will be regarded as abandoned, and if not promptly removed or marked as above provided will subject the permittee or owner to prosecution, and any trap not in use on which the license number is not displayed will be subject to removal by the United States at any time.

7. That if future operations by the United States require an alteration in the position of the weir, trap, or pound, or if the latter, in the opinion of the Secretary of War, shall cause unreasonable obstructions to the free navigation of the said waters, the permittee will be required, upon due notice from the Secretary of War, and within 30 days thereafter, to remove or alter the weir, trap, or pound, or obstruction caused thereby, without expense to the United States, so as to render navigation reasonably free, easy, and unobstructed. No claim shall be made against the United States on account of such removals or alterations.

8. That fishing structures and appliances in navigable waters of the United States shall be lighted for the safety of navigation, as follows:

"The lights shall be displayed between sunset and sunrise. They shall be placed at each end of the structure, excepting where the inner end terminates in such situation that there is no practicable navigation between it and the high-water line of the adjacent coast, in which case no inner light shall be displayed. The outer light shall be white and the inner light shall be red. The size, capacity, and manner of maintenance of the lights shall be such as may be specified in the War Department permit authorizing the erection of the structure or appliance.

"When several structures or appliances are placed on one line with no navigable passage between them they will be considered, for lighting purposes, as one structure."¹

9. That there shall be installed and maintained on the weir, trap, or pound, by and at the expense of the permittee, such additional lights and signals as may be prescribed by Bureau of Lighthouses, Department of Commerce, and that provision shall be made by watchman or otherwise for proper attendance of lights and signals, so that they will at all times be in effective condition.

10. That this authority is revocable at will by the Secretary of War, and unless otherwise specified in the permit, or unless previously revoked under paragraph 7 above, shall cease and be null and void. (Date to be specified by the district engineer, not more than five years after date of issuance of permit.)

Recommended:

LANSING H. BEACH,
Major General, Chief of Engineers.

Approved:

W. R. WILLIAMS,
Assistant Secretary of War.

ALASKA FISHERY INTELLIGENCE SERVICE.

Through the cooperation of the Alaska Military Telegraph & Cable System, information was sent to and posted at frequent intervals in the telegraph offices at Wrangell, Petersburg, Craig, Sitka, Juneau, Cordova, and Seward, reporting the price of fresh halibut, sablefish, and red rockfish at Ketchikan. At less frequent intervals the price of pickled salmon and herring was also reported. In like manner the Seattle price for the same fresh and pickled fish was reported to those towns and to Ketchikan. This service is understood to have been of real value to the fishermen in enabling them to take advantage of the best market for their products, and it was continued for their benefit.

INSPECTION OF CANNERIES.

Canneries in Alaska are subject at all times to inspection by employees of the Alaska service of the bureau, but this inspection is limited chiefly to an examination of the fish with reference to the time they have been dead. The inspection also includes the wanton waste of food fish in Alaska, whether at the fishery establishments or on the fishing grounds.

There is also a cannery inspection service authorized by the National Canners' Association but supported largely if not entirely by the packing companies operating canneries in Alaska or by as many of them as contribute to the maintenance of the service. The plants of companies which do not contribute are not inspected by employees of that service. This work is somewhat in its infancy, having been started rather experimentally two years ago chiefly, it is understood, to reduce the fire risk at the canneries, to further provide for satisfactory sanitation at the plants, and to promote the general welfare and comfort of employees. The work of this service is no doubt well worth while, although it has no mandatory authority to prevent the

¹ Regulations of Department of Commerce, approved June 19, 1913.

canning of fish which in the judgment of its employees should not be canned. The superintendent of the plant is ordinarily the responsible head of affairs, with absolute control of operations, and is thus not definitely bound by the actions, recommendations, or suggestions of the inspectors.

In 1920 this private inspection service was competently conducted under the supervision of Dr. E. D. Clark, of Seattle, who for many years was identified with the U. S. Bureau of Chemistry. Its personnel was made up chiefly of students from the Fisheries College at the University of Washington. The Government has no direct connection with the inspection service thus maintained under the auspices of the National Cannery Association but approves of its general purposes and objects.

VIOLATIONS OF FISHERIES LAWS AND REGULATIONS.

Fishery work before the courts of Alaska in 1920 involved prosecutions for failure to close the tunnels and open the heart walls of traps during the weekly close season, fishing in streams and lakes closed to commercial operations, fishing within 500 yards of the mouths of salmon streams, disregard of the lateral distance interval between fixed appliances, and the wanton waste of salmon. It also covered the completion of prosecutions begun in 1919. In most cases the penalties imposed were fines, though in one case the sentence was imprisonment for one month. Fines aggregated \$6,480.95, of which amount \$101 was imposed in central Alaska, \$158.80 in western Alaska, and \$6,263.15 in the southeastern district. Costs of prosecutions, which ordinarily follow the judgments, are included in these amounts, as far as they were reported, but the record is incomplete as in several instances the costs had not been computed at the time reports were made. The total amount of penalties would therefore be increased somewhat by including these costs.

On September 13, 1919, William Strong was indicted at Juneau as an alien, having engaged in fishing in Taku River August 3, 1919. The case came to trial on March 4, 1920, at which time Strong pleaded guilty and was fined \$100.

The Alaska Pacific Fisheries was indicted in 1919 for not opening the heart walls of two traps on Sunday, August 3, 1919, and tried at Ketchikan. The jury failed to agree on a verdict. On April 28, 1920, the case was again tried in the district court at Ketchikan and resulted in an acquittal of the company.

On July 17 the Alaska Pacific Fisheries was accused in a complaint filed before the United States commissioner at Juneau of failing to close the tunnel of its trap at Neck Point, Chichagof Island, during the weekly close period on July 11. The case was tried on August 6, but the jury did not agree on a verdict. Subsequently the case was dismissed on motion of the United States attorney.

The case against the Ward's Cove Packing Co., indicted in the fall of 1919 for fishing with two traps on Sunday, August 3, 1919, was called for trial at Ketchikan, April 26, 1920. The company pleaded guilty and was fined \$200 and costs.

On November 23, 1920, the Ward's Cove Packing Co. was indicted at Ketchikan for illegally fishing with a trap in Clarence Strait 4

miles north of Dall Head on August 2. The case was continued to the March, 1921, term of court.

At the April term of court in Ketchikan, Gus Starkloff, who was indicted the previous fall for unlawful fishing in Stacey Creek, Prince of Wales Island, September 22, 1919, was arraigned, pleaded guilty, and paid a fine of \$50.

At the same term of court Jack Peratovich and five other natives were arraigned under an indictment accusing them of fishing with a seine in Stacey Creek in 1919 contrary to law. They pleaded guilty and were each fined \$50.

In October, 1919, T. Kato, a Japanese, was indicted as an alien for fishing with a gill net in the waters of southeastern Alaska on June 5, 1919. The case was called for trial at Ketchikan on April 30 and resulted in an instructed verdict for the defendant, it having been testified that he was not fishing, but was merely demonstrating the use of a gill net.

Jenkins & Jenkins were indicted in 1919 at Ketchikan for having driven a trap within a lateral distance of 600 yards of a floating trap then in operation. The case was tried in Ketchikan in April, 1920, resulting in an acquittal of the defendants on the ground that the floating trap was movable, and that therefore only the lateral distance interval of 100 yards was applicable in this instance.

At the September, 1919, term of the district court held at Juneau, Tony Flagas was indicted for fishing in Berners Bay during the close season on September 15, 1919. Counsel for the defendant demurred to the indictment for the reason that it did not state that Flagas was fishing for salmon. The demurrer was sustained, and the violation is therefore in the status of having been unreported.

On Sunday, May 23, Paul Rappas was found fishing with a gill net in Shoemaker Bay. On May 24 a complaint was filed against Rappas before the United States commissioner at Wrangell, whereupon he pleaded guilty and was fined \$120 and costs of \$8.

On September 15, 1919, Pete Knutsen and Ole Knutsen were indicted on two counts for (a) fishing in Petersburg Creek with a gill net covering more than one-third the width of the stream and (b) fishing with a gill net extending across more than one-third the width of the water of the estuary at Petersburg Creek. They were tried at Ketchikan on November 8, 1919, and convicted on the second count. On November 15 motion for a new trial was made. It was denied on November 13, 1920, and a fine of \$250 and costs was imposed. Notice of an appeal was then given but was not completed, and the fine and costs of \$56.65 were paid later.

The case against the Hidden Inlet Canning Co., indicted in the fall of 1919 for constructing in Peril Strait, near False Island, a fish trap within 500 yards of the mouth of a salmon stream, was tried at Juneau October 11, 1920, and resulted in an acquittal of the company, there being no satisfactory evidence presented to the jury that the stream was used by salmon.

In September two indictments were returned against the Hidden Inlet Canning Co. The first covered two counts and accused the company of not closing the tunnels of two traps on Sunday, July 18. Both traps were located on Chichagof Island, one being one-fourth of a mile south of White Rock and the other 2 miles north of Basket Bay. A plea of guilty on each count was entered when the case was called for trial in October, and a fine of \$50 for each offense

was imposed. The second indictment alleged that the company had not closed on Sunday, July 25, the tunnel of a trap located on Chichagof Island $3\frac{1}{2}$ miles south of South Passage Point. Upon being arraigned the company pleaded guilty and was fined \$100. This violation was originally reported in a complaint filed before the United States commissioner at Juneau on August 31, but it was subsequently reported to the grand jury upon dismissal of the complaint.

On September 13 complaint was made before the United States commissioner at Juneau against Libby, McNeill & Libby charging it with failure to close the tunnel of its Douglas Island trap, near Shoal Point, during the weekly close season on September 5. Arraignment was made immediately upon issuance of the complaint. The company pleaded guilty and was fined \$100 and costs of \$2.85. Complaint was also made against Paul Benson and John Smith, watchmen at the trap. Both men pleaded guilty and paid a fine of \$25 each and costs of \$2.85.

In November, F. Lloyd was indicted at Ketchikan for illegally operating a floating trap near Harry Bay, during the weekly close period on July 31, by not opening the heart walls and not closing the tunnel. On December 9 the case was called and a plea of guilty was entered. The defendant was fined \$50 and paid costs of \$90.65.

On August 2, a trap on the west shore of Gravina Island, 3 miles north of Dall Head, belonging to Rounsefell & Co., was found in full fishing order. Report was made to the grand jury at Ketchikan, and, on November 23, a true bill was returned. The case was called for trial in December and the company pleaded guilty. A fine of \$100 and costs of \$21.05 were imposed.

On Sunday, August 1, a trap of the Jensen Fish Co. located in Nichols Passage near Blanks Inlet was found with heart walls closed and tunnel only partly closed. These facts were presented to the grand jury in Ketchikan on November 23 and an indictment resulted. The company pleaded guilty on December 8, and was fined \$100 and costs of \$45.

On July 7 complaint was filed before the United States commissioner at Juneau, charging that the Marathon Fishing & Packing Co. had not closed on Sunday, July 4, the tunnel of a trap operated by it on Admiralty Island, $1\frac{1}{2}$ miles south of Gambier Bay. The case was called for trial on August 19, when the defendant pleaded guilty and paid a fine of \$200.

On July 7 the Petersburg Packing Corporation was accused in a complaint filed at Juneau before the United States commissioner of not closing, on July 4, the tunnel of its pile trap located on the south shore of Admiralty Island, one-half mile northeasterly from Deep-water point. Similar complaints were made against A. J. Young and Jesse Fowler, watchmen at the trap. The cases were called for trial on August 2. The company pleaded guilty and was fined \$200 and costs of \$5. The complaints against the watchmen were dismissed for the reason that they claimed it was impossible for them to close the tunnel.

On July 7 complaint was filed before the United States commissioner at Juneau, charging the Petersburg Packing Corporation with failure to close on Sunday, July 4, the tunnel of a floating trap

located 1 mile southeast of Point Brightman, Admiralty Island. The case was dismissed on motion of the United States attorney.

On July 7 complaint was filed before the United States commissioner at Juneau alleging that the Washington Bay Packing Co. had not closed the tunnel of a trap on the southeast shore of Admiralty Island, one-half mile southeast of Point Brightman, supposedly owned and operated by that company, on Sunday, July 4, though at that time the trap bore no name, number, or other means of identification. The complaint was subsequently withdrawn, as the company disclaimed ownership of the trap. However, on July 23, when the trap was again inspected, it carried the name of the Washington Bay Packing Co. In view of that fact, the matter was presented, on September 17, to the grand jury at Juneau, and an indictment resulted. The case was tried October 28, and the company was acquitted.

On September 17 the Washington Bay Packing Co. was also indicted for not having closed on Sunday, July 4, the tunnel of its trap located on the south shore of Admiralty Island, $2\frac{1}{2}$ miles northeast of Woewodsky Harbor. When the case was called for trial in October, the company pleaded guilty and was fined \$100 and costs.

On July 7 the Southern Alaska Canning Co. was accused in a complaint filed before the United States commissioner at Juneau of not closing on Sunday, July 4, the tunnels of two of its floating traps, one of which was located at Point Napean and the other at Point Wilson, on the south and west shores, respectively, of Admiralty Island. Trial was had July 20, when a plea of guilty was entered. A fine of \$400 and costs of \$8.60 were paid. A similar complaint was made against Lenard Ekholm, watchman at the Point Wilson trap, but it was dismissed on condition that he should not again violate the law by leaving the tunnel open during the remainder of the close seasons of the year.

On August 31 the Southern Alaska Canning Co. was further accused in a complaint filed before the United States commissioner at Juneau of having failed to provide during the weekly close season beginning July 24 an opening for the free passage of salmon and other fish through the heart of its trap located 1 mile north of Point Gardiner, Admiralty Island. The peculiarity of this case was that the company technically complied with the law by opening the heart walls, but it had, in fact, obstructed the passage of fish through the opening thus made by extending a jigger from the heart to the pot, thus, in effect, circumventing the law. Prosecution was vigorously contested, but a conviction resulted, whereupon the company was fined \$350.

On July 7 the Sanborn-Cutting Co. was accused in a complaint filed before the United States commissioner at Juneau of having violated the law in two instances, Sunday, July 4, in not closing the tunnels of two of its floating traps, located, respectively, in Herring Bay, Admiralty Island, and Frederick Sound north of Carroll Island. The case was called for trial July 17, at which time the company pleaded guilty and paid a fine of \$250 and costs of \$8.70. D. Simmons, watchman at the Herring Bay trap, against whom a complaint was also made, pleaded guilty and was fined \$100 and costs of \$35.30. There was no watchman at the other trap.

On July 7 the Fidalgo Island Packing Co. was accused in a complaint filed at Juneau before the United States commissioner of not closing on Sunday, July 4, the tunnel of a trap on the southern shore of Admiralty Island. Upon being arraigned July 26 the company pleaded guilty and paid a fine of \$150 and costs of \$8.

On August 31 the Fidalgo Island Packing Co. was further accused in a complaint filed before the United States commissioner at Juneau of not closing the tunnels of two traps on the southern shore of Admiralty Island during the weekly close season July 24. The traps were located one-third and $1\frac{1}{4}$ miles, respectively, northeast of Murder Cove. The company pleaded guilty to both offenses on September 9 and paid a fine of \$200 and costs of \$3.85.

On July 17 a complaint was filed before the United States commissioner at Juneau accusing the Booth Fisheries Co. of not closing the tunnel of two of its traps on Sunday, July 11. Both traps were located on the northern shore of Chichagof Island, one near Point Augusta and the other seven-eighths of a mile southeasterly from Pulizzi Island. The case was tried August 6 and resulted in an acquittal of the company. A complaint was also filed against Carl Edensword and Karl Christensen, watchmen at the Point Augusta trap, similarly charging them, but they were likewise acquitted. There was no watchman at the other trap.

On July 17 the Deep Sea Salmon Co. was accused in a complaint filed before the United States commissioner at Juneau of not closing the tunnels of two of its traps on Sunday, July 11. Both traps were located on the northern shore of Chichagof Island, one near White-stone Harbor and the other near Spasskaia Bay. When the case came up for trial July 19 the company pleaded guilty and was fined \$100 and costs of \$4.20. Complaint was also made against Theodore Thorsen, watchman at one trap. Upon being arraigned, he pleaded guilty and was fined \$100 and costs of \$5. No watchman was found at the other trap.

On August 31 the Wilson Fisheries Co. was accused in a complaint filed before the United States commissioner at Juneau of two violations of the law in that two of its traps were not closed on Sunday, July 25. The traps were located at or near Wilson Cove, Admiralty Island. The case was called on September 14 but was dismissed on motion of the United States attorney, as the Government had but one witness.

A complaint filed before the United States commissioner at Juneau on August 31 accused the Standard Salmon Packers (Inc.) of failing to close on Sunday, July 25, the tunnel of its trap in Tenakee Inlet, 4 miles west of South Passage Point. Upon being brought to trial September 3 the company pleaded guilty and paid a fine of \$50 and costs of \$3.85.

On August 27 the Auk Bay Salmon Canning Co. and Charles Smith, owner and watchman, respectively, were accused in a complaint filed before the United States commissioner at Juneau of not closing the tunnel of the company's trap at Outer Point, Douglas Island, during the weekly close season on August 7. The case was called for trial on August 28, when both defendants pleaded guilty. The company was fined \$100 and costs of \$2.85, and the watchman \$25 and costs of \$2.85.

On July 17 P. E. Harris & Co. was accused in a complaint filed before the United States commissioner at Juneau of five violations of the law on Sunday, July 11, in that the tunnels of five of its traps on the western shore of Mansfield Peninsula were not closed. The trial was held on August 6 and resulted in a conviction on one count and disagreement on the other four. The company was fined \$500, upon payment of which the four other counts were dismissed.

On August 31 P. E. Harris & Co. was accused in a complaint filed before the United States commissioner at Juneau of not closing on Sundays, August 1 and 8, the tunnel of one of its floating traps on the western shore of Mansfield Peninsula. The case was tried on September 3 and resulted in a conviction and fine of \$350 and costs. An appeal was taken. A complaint was also made against D. A. Demick, trap watchman, but it was dismissed. Subsequently the same information was laid before the grand jury and an indictment returned. These cases were consolidated and tried before the district court on November 5 and 6, and a conviction again secured. Motion for a new trial being denied, the court imposed a fine of \$350 and costs against the company and a fine of \$50 and costs against Demick.

P. E. Harris & Co. and Jack Carlson, owner and watchman, respectively, of a trap located $3\frac{1}{2}$ miles north of Hawk Inlet on the western shore of Mansfield Peninsula, were indicted separately by the grand jury at Juneau in September for not closing the tunnel of the trap on Sunday, August 1. The original action in respect to this violation was the filing of a complaint against the company and watchman before the commissioner at Juneau, but on motion of the United States attorney the complaints were dismissed and the matter presented to the grand jury, thus avoiding retrial in event of a conviction in the lower court and appeal to the district court. The company was tried on November 3 and 4 and acquitted. The bench warrant for Jack Carlson was returned unserved, he having left Alaska before the date of his indictment.

In September P. E. Harris & Co. was indicted for not closing on Sunday, August 8, the tunnel of its pile trap located $2\frac{1}{2}$ miles south of Hawk Inlet, Admiralty Island. This case was first taken before the United States commissioner at Juneau on a complaint filed August 31, but that action was dismissed on September 11.

At the same term of court another indictment was returned against P. E. Harris & Co., alleging that this same trap did not have its tunnel closed on Monday, August 9, during the close season on that day. The indictment contained a further count which alleged that the tunnel of a floating trap owned by this company and located one-half mile north of Hawk Inlet was not closed during the same close season. As in similar cases, complaints were first filed before the commissioner at Juneau alleging the commission of offenses as above indicated, but they were dismissed in order that the facts could be presented to the grand jury with the result as noted.

On August 31 two complaints were filed before the commissioner at Juneau accusing P. E. Harris & Co. of not closing on Sundays, August 15 and 22, the tunnel of a pile trap located $2\frac{1}{2}$ miles south of Hawk Inlet. These complaints were dismissed, and the information they contained was laid before the grand jury with the result that a

true bill was returned. These three cases were tried on November 1, 3, and 4, and an acquittal secured in each one.

On August 16 Ben Fox and Bert Dennis, natives, were charged in a complaint filed before the United States commissioner at Haines with having on that day fished with a gill net in Chilkoot River. They pleaded guilty and were each fined \$5.

On August 31 C. H. Gallagher was accused in a complaint filed before the United States commissioner at Juneau with not closing on Sundays, August 15 and 22, the tunnel of his trap located on the northern end of Chichagof Island between Hoonah Island and Flynn Cove. The case was called for trial September 7. Gallagher pleaded guilty and was fined \$25 and costs amounting to \$41.85.

On August 23 the Beegle Packing Co. was accused in a complaint filed before the United States commissioner at Ketchikan of fishing with a floating trap on the southern shore of Revillagigedo Island west of Coho Cove during the weekly close season of August 22. The company pleaded guilty when the case was called for trial and paid a fine of \$100.

On August 27 the Alaska Sanitary Packing Co. was charged in a complaint filed before the United States commissioner at Wrangell with having failed to open during the close season on August 7 the heart walls of two traps located on Prince of Wales Island 4 miles north of Point Baker. The company claimed extenuating circumstances in defense, but pleaded guilty and paid a fine of \$25 for each trap and total costs of \$9.20.

Charles Norberg was accused in a complaint filed before the United States commissioner at Petersburg on August 30 of fishing with a purse seine within the prohibited distance of the mouth of Blind River, Mitkof Island, on August 3. He pleaded guilty and was fined \$30 and costs.

By a complaint filed before the United States commissioner at Petersburg on August 30 Jack Hollingstad was also accused of fishing with a purse seine within the closed area at the mouth of Blind River on August 7. Upon arraignment he pleaded guilty and paid a fine of \$40 and costs.

In September Chester Worthington, a native of Wrangell, was accused by the grand jury at Juneau of illegal fishing August 24 in a salmon stream of Port Houghton. The case was tried at Juneau, October 15, and resulted in a conviction. On October 19 Worthington was sentenced to serve one month in the Federal jail at Juneau.

The Pacific American Fisheries was indicted in September for not closing on August 14 the tunnel of one of its pile traps located on the southern shore of Pleasant Island. The case was called at Juneau on October 22, and the trial ended in a conviction of the company. Motion for a new trial being made and denied, the company, on November 13, was fined \$300 and costs of \$42. Notice of an appeal was entered, but upon the expiration of the period in which a bill of exception might be filed the company paid the fine, thus closing the case.

On August 7 Jack David and Patty Gonate, natives, were caught fishing with gill nets in Chilkoot Lake. They were so accused in a complaint filed that day before the United States commissioner at Haines. Both men pleaded guilty, and each paid a fine of \$20 and costs of \$16.

On November 23 complaint was filed in the United States commissioner's court at Ketchikan accusing the Fresh Fish Co. of fishing during the weekly close season on August 1 with a trap located on the eastern shore of Prince of Wales Island, $3\frac{1}{2}$ miles north of Cape Chacon. The company pleaded guilty and paid a fine of \$50 and costs of \$5.50.

The Starr-Collinson Packing Co. was indicted at the November term of court in Ketchikan for not opening the heart walls of its trap No. 748, Prince of Wales Island, during the weekly close season on August 1. The case has not been tried.

On July 21 a complaint was filed before the United States commissioner at Latouche accusing the Copper River Packing Co. and Kentuck Graves and Edward Hammer, two of its fishermen, of setting a gill net in Eshamy Lagoon on July 15 a distance of 192 feet from a net of the Kenai Packing Co. Upon trial, pleas of guilty were entered and a fine of \$25 and cost was imposed.

A second complaint was filed on July 21 in the same court, charging the Copper River Packing Co., Kentuck Graves, and Edward Hammer with setting another gill net a distance of 182 feet from the net of the Kenai Packing Co. Graves assumed responsibility and pleaded guilty when the case was called for trial. He was fined \$25 and costs.

On July 1 a complaint was filed before the United States commissioner at Valdez, charging the Copper River Packing Co. with having set a trap within 500 yards of the mouth of a salmon stream on Chenega Island. The trial of the case began August 10 and continued until noon August 12. The defendant company was acquitted, the court holding that the mouth of the stream was above the lagoon, a distance of more than 500 yards, and, further, that the stream was not one in which salmon could spawn or would be chosen by salmon for spawning.

On July 21 a complaint was filed before the United States commissioner at Latouche, accusing the Copper River Packing Co., Kentuck Graves, and Edward Hammer of setting a net on July 15 within 500 yards of the mouth of a red salmon stream emptying into Eshamy Lagoon. When the case came up for trial, July 24, the defendants produced as witness a surveyor who disputed the measurements made by a witness for the Government. The case was finally dropped on condition that the company vacate the site, which it did.

On July 21 complaint was filed before the United States commissioner at Latouche charging that A. Gustofson and J. S. Groll had fished with two traps at the entrance of Eshamy Lagoon on Sunday, July 18. Gustofson assumed responsibility, pleaded guilty, and was fined \$1 and costs for each offense.

On July 21 the King Salmon Fisheries Co. was accused in a complaint filed before the commissioner at Latouche of having set on July 14 two nets within 500 yards of the mouth of Miners River, a red salmon stream tributary to Unakwik Inlet, Prince William Sound. J. S. Groll, superintendent for the company, H. L. Neilson and W. St. Clair, fishermen, appeared as defendants in the case. Pleas of guilty were entered, and a fine of \$25 and costs was imposed in each case.

During the weekly close season on Saturday, July 10, a trap at Knowles Head belonging to the Moore Packing Co. was found to

be fishing. Complaint was entered before the United States commissioner at Cordova, and the case tried on August 6. The company was acquitted.

The Carlisle Packing Co. was accused in a complaint filed before the commissioner at Cordova of fishing with a trap at Porcupine Point during the weekly close season on Saturday, July 10. The case was tried August 6 at Cordova, but the jury failed to agree on a verdict. On motion of the assistant United States attorney the case was dismissed.

At the October term of the district court at Valdez the grand jury indicted the Kenai Packing Co. and the Copper River Packing Co. for the wanton waste of salmon. The Copper River Packing Co. was also indicted for not opening the heart walls of its trap in Prince of Wales Passage during the weekly close season on August 15. The cases will not be tried until 1921.

On July 27 the Bristol Bay Packing Co. was accused in a complaint made in the United States commissioner's court at Koggiung of fishing on July 5 with a gill net in Naknek River, contrary to the closing order of December 18, 1920. A plea of guilty was entered and a fine of \$38.60, being the costs of the prosecution, was imposed.

On July 28 another complaint, charging that two boats belonging to the Bristol Bay Packing Co. and the Red Salmon Canning Co. were fishing in Naknek River on the night of July 12, was entered before the commissioner at Koggiung. The accused pleaded guilty and were fined the costs of the prosecution, amounting to \$66.60.

On July 29 a complaint filed before the commissioner at Koggiung alleged that the Alaska Packers Association had fished with a drift gill net in Naknek River on July 5. When the case was called a plea of guilty was entered, and a fine of \$10 and costs of \$43.60 was imposed.

The Circuit Court of Appeals of the Ninth Circuit, sitting at San Francisco, affirmed the sentence and judgment imposed on the Canoe Pass Packing Co. and the Northwestern Fisheries Co., jointly indicted in October, 1918, and convicted in the district court at Valdez in October, 1919. These companies were indicted on four violations of the regulations affecting fishing in Copper River by having set four nets in Miles Lake, which is a part of the river, within the prohibited distance of other nets previously set. The trial court imposed a fine of \$1,000 and costs against each company, or \$250 for each count in the indictment.

TERRITORIAL TAX LAW UPHELD.

In October, 1919, an action was brought in the Supreme Court of the United States on writ of error from a judgment of the District Court for the District of Alaska, Division Number One, dismissing the suit of the Alaska Fish Salting & By-Products Co., plaintiff in error, against Walstein G. Smith, treasurer of Alaska, defendant in error, to recover money paid as taxes by the plaintiff to the defendant for the tax years 1917 and 1918 under chapter 74, Alaska Session Laws, 1917, enacted by the Alaska Territorial Legislature.

There were originally two suits. The first one was brought in 1918 to recover the 1917 tax of \$2 per barrel on 4,112 barrels of fish

oil, amounting to \$8,224, and the tax of \$2 per ton on 1,037 tons of fish meal, amounting to \$2,074, making a total tax of \$10,298, for which judgment was asked, together with interest thereon at 8 per cent per annum from January 14, 1918. The second suit, for 1918 taxes, was filed on February 17, 1919, to recover the tax of \$2 per barrel on 2,720 barrels of fish oil, amounting to \$5,440, and the tax of \$2 per ton on 645 tons of fish meal, amounting to \$1,290, making a total tax of \$6,730, for which judgment was asked, together with interest thereon at 8 per cent per annum from January 15, 1919.

Eight assignments of error were presented and based on the action of the trial court in sustaining demurrers, dismissing the complaints, denying plaintiff's motion for judgment, and rendering judgment against the plaintiff, and thus upholding the constitutionality and validity of the act of the Territorial Legislature and the taxes imposed thereby. The plaintiff company, through its attorney, filed a brief before the United States Supreme Court on December 2, 1920, setting forth at length the contention that the legislation imposing the tax, to avoid which this litigation was had, contravened and violated the Constitution of the United States, particularly the fifth and fourteenth amendments, in that the plaintiff was denied the equal protection of the law and was deprived of its liberty and property without the process of law; that the legislative classification of plaintiff's business was so arbitrary and unreasonable as to constitute class legislation, and that the tax was confiscatory and prohibitive, and that it was not laid on other businesses or industries which were essentially the same as plaintiff's business; that the legislation was a clear abuse of the Territory's legislative authority, and that it accomplished, by means of an intentionally arbitrary and confiscatory exaction imposed under the guise of a tax, the unauthorized destruction and confiscation of a lawful pursuit; that the legislation was a clear, arbitrary discrimination against the manufacture of fish oil and fish meal from herring in whole or in part, although there was no reasonable distinction between that business and other businesses in all essentials similar thereto carried on in Alaska upon which no tax whatsoever was laid; that the legislation, if deemed to be a police regulation, was unreasonable and unauthorized, as Congress had expressly reserved police supervision and control of the fisheries to itself; that the legislation was extortionate, unfair, and prohibitive, and so confiscatory as to result in a tax of 113.64 per cent of the net profits for one year; and that the legislation and the taxes imposed thereby violated the Alaska Organic Act in that they were not uniform on all occupations or businesses, nor were they uniform on all businesses of the same class; that the tax exceeded 1 per cent of the actual value of plaintiff's property, and that it was not levied or assessed on the actual value of the property, but was purely an arbitrary imposition in utter violation of the constitutional limitations of the Alaska Organic Act.

On January 31, 1921, the Supreme Court handed down a decision affirming the judgment of the trial court. In view of its interest to the fishery industry of Alaska the opinion is here quoted in full, as follows:

This is an action to recover the amount of taxes levied under statutes of Alaska which the plaintiff alleges to be contrary to the act of Congress of August 24,

1912, c. 387, § 3, 37 Stat. 512, creating a legislative assembly in the Territory of Alaska, and to the Constitution of the United States. Judgment was given for the defendant upon demurrer to the complaint, the parties agreeing that the foregoing grounds of recovery were the only matters in dispute. The statutes attacked, viz: May 1, 1913, April 29, 1915, and May 3, 1917, levy license taxes of two dollars a barrel and two dollars a ton respectively, upon persons manufacturing fish oil, fertilizer and fish meal in whole or in part from herring. The Act of Congress after giving effect to the Constitution and laws of the United States in the Territory provides that the authority therein granted to the legislature "to alter, amend, modify, and repeal laws in force in Alaska shall not extend to the * * * fish * * * laws * * * of the United States applicable to Alaska, or to the laws of the United States providing for taxes on business and trade * * * *Provided further*, that this provision shall not operate to prevent the legislature from imposing other and additional taxes or licenses." Some reliance is placed also upon § 9 that all taxes shall be uniform upon the same class of subjects, &c., and that no tax shall be levied for territorial purposes in excess of one per centum upon the assessed valuation of property therein in any one year.

The complainant alleges that the tax will prohibit and confiscate the plaintiff's business, which is that of manufacturing fish oil, fertilizer, fish meal and by-products from herring either in whole or in part; that the tax unreasonably discriminates against the plaintiff, as it levies no tax upon the producers of fish oil, &c., from other fish, and is otherwise extortionate; and that it contravenes the Act of Congress in lack of uniformity and in exceeding one per centum of the actual value of the plaintiff's property. The prophecies of destruction and the allegations of discrimination as compared with similar manufactures from salmon are denied by the Attorney General for Alaska, the latter denial being based upon a comparison of the statutes which of course is open. We are content however to assume for the purposes of decision that, not to speak of other licenses, the questioned Acts do bear more heavily upon the use of herring for oil and fertilizer than they do upon the use of other fish. But there is nothing in the Constitution to hinder that. If Alaska deems it for its welfare to discourage the destruction of herring for manure and to preserve them for food for man or for salmon, and to that end imposes a greater tax upon that part of the plaintiff's industry than upon similar use of other fish or of the offal of salmon, it hardly can be said to be contravening a Constitution that has known protective tariffs for a hundred years. *Rast v. Van Deman & Lewis Co.*, 240 U. S. 342, 357. Even if the tax should destroy a business it would not be made invalid or require compensation upon that ground alone. Those who enter upon a business take that risk. *McCray v. United States*, 195 U. S. 27. See *Quong Wing v. Kirkendall*, 223 U. S. 59; *Mugler v. Kansas*, 123 U. S. 623; *Louisville & Nashville R. R. Co. v. Mottley*, 219 U. S. 467, 482. We need not consider whether abuses of the power might go to such a point as to transcend it, for we have not such a case before us. The Acts must be judged by their contents not by the allegations as to their purpose in the complaint. We know of no objection to exacting a discouraging rate as the alternative to giving up a business, when the legislature has the full power of taxation. The case is different from those where the power to tax is limited to inspection fees and the like, as in *Postal Telegraph & Cable Co. v. Taylor*, 192 U. S. 64, 72.

But it is said that however it may be with regard to the Constitution taken by itself, the statutes brought into question are contrary to the Act of Congress from which the local legislature derives its power. In the first place they are said to be an attempt to modify or repeal the fish laws of the United States. The Act of Congress of June 6, 1900, c. 786, § 29; 31 Stat. 321, 331; Alaska Compiled Laws, § 2569; imposes a tax on fish oil works of ten cents per barrel and on fertilizer works of twenty cents per ton, repeated in slightly different words by the Act of June 26, 1906, c. 3547; 34 Stat. 478; Alaska Compiled Laws, § 259. But these are not fish laws as we understand the phrase. It is argued, however, that at least they import a license, *License Tax Cases*, 5 Wall. 462, 470, and that a tax alleged to be prohibitory flies in their teeth. It would be going far to say that a tax on fish oil works in general terms imported a license to a specific kind of works deemed undesirable by the local powers, and when we take into account the express and unlimited authority to impose additional taxes and licenses we are satisfied that the objection should not prevail. We confine our decision to the statutes before us, repeating in this connection that

they must be judged by their contents not by the characterization of them in the complaint.

The requirement of uniformity in § 9 is disposed of by what we have said of the classification when considered with reference to the Constitution. The legislature was warranted in treating the making of oil and fertilizer from herring as a different class of subjects from the making of the same from salmon offal. The provisions against taxing in excess of one per centum of the assessed valuation of property does not apply to a license tax like this. This is not a property tax, *Alaska Pacific Fisheries v. Territory of Alaska*, 236 Fed. Rep. 52, 61. The objection that the plaintiff in error is doubly taxed, first by the United States and then by the Territory, is answered by the express authority to levy additional taxes to which we have referred heretofore. Without going into more detail we are of opinion that the tax must be sustained.

ROBBERY OF FISH TRAPS.

The fishing season of 1920 was marked by a renewal in southeast Alaska of the piratical operations of 1919, which caused the packers considerable loss of salmon. The regions chiefly affected were the Cape Fox district, Craig and vicinity, Icy Strait, and the northern part of Chatham Strait. The first robberies were reported in June, and from that time until the middle of August depredations occurred at short intervals. Calls for assistance in putting down the disorder were made to officials of the district court and to the governor of Alaska, who was instrumental in securing the presence in Alaskan waters of certain vessels of the Navy, supposedly for the better enforcement of all laws and especially the suppression of this particular form of lawlessness.

Subchaser *No. 294* was almost constantly engaged in patrolling the southern districts while subchaser *No. 310* made infrequent cruises into the northern localities. But with all these activities the unlawful taking of salmon was not stopped thereby. In September information was presented by one packing company to the grand jury at Juneau which indicted four men who had operated in the Icy and Chatham Straits region, but when the case came on for trial it was dismissed against three of them for lack of sufficient evidence while the other one was tried and acquitted.

Investigation has shown that much of this so-called piracy was the purchase of salmon from dishonest trap watchmen. Negotiations were unsuccessful when they were undertaken with faithful, upright watchmen. In some instances salmon were taken from unwatched traps, but the number so secured must have been small, as all traps making even fair catches of salmon were watched by one or more men.

Of further interest in this connection is the fact that salmon were taken chiefly from floating traps, owing to the ease with which fish could be removed from such apparatus, there being no material change of conditions at any stage of the tide. With but occasional exceptions, it is improbable that more than a few hundred salmon were taken or purchased at any one time, for the boats engaged in the business were small and manned by very few men. Most reports of large losses of salmon from this cause must be regarded as exaggerated, for in view of the scarcity of salmon many traps making even moderate catches were carefully guarded by reliable employees, who in some instances are said to have easily frightened away would-be thieves by the discharge of firearms.

In the last analysis, the suppression of this business appears to be almost wholly in the hands of the cannerymen and the operators of traps themselves. It seems reasonable to conclude that refusal to purchase salmon from suspicious sources and the employment of honest watchmen will make it unprofitable and cause the entire cessation of the reprehensible practice.

TERRITORIAL FISH COMMISSION.

The Alaska Territorial Fish Commission was created by the legislature at its session early in 1919, and at the same time the sum of \$80,000 was appropriated for its work during the ensuing biennium. The efforts of the commission have been devoted chiefly to fish-cultural work, the removal of natural barriers in salmon streams, and the destruction of predatory trout. The commission has issued two printed reports covering its activities during each of the two years ending March 31. According to the report for the biennium ending March 31, 1921, there was expended in the first year \$27,901.24, and in the second year \$40,143.66, thus leaving an unexpended balance of \$11,955.10. Of the \$27,901.24 expended in the first year, \$12,072.08 was spent for fish-cultural work, \$6,373.98 for stream improvement, and the balance for general expenses, permanent improvements, etc. Of the \$40,143.66 spent in the second half of the biennium, \$16,573.71 was chargeable to propagation and \$19,695.90 to stream improvement and the destruction of predatory fish, the balance going for general expenses.

According to the reports of the commission, stream improvement work in 1919 was accomplished as follows: Juneau district, seven streams; Ketchikan district, eight; Cordova district, three; and Seward district, three. In 1920 this work was upon a more extensive scale, being reported as follows: Juneau district, seven streams; Ketchikan district, various streams south of Wrangell Narrows, number not stated; Cordova district, five; and Seward district, eight. It is reported also that in the Juneau district 10,000 predatory fish were destroyed, and in the Cordova district 13,648 were destroyed. Mention is made also of the destruction of a considerable number of predatory fish in the Bristol Bay district. Figures in respect to this, however, are covered by the report by Dennis Winn, field superintendent of fish-cultural work for the Bureau, appearing on page 31. The Territory contributed \$2,000 toward the fund for conducting this work in Bristol Bay.

Details as to the fish-cultural and hatchery work of the commission will be found in the section of this report devoted to hatcheries.

TERRITORIAL LICENSE TAX.

Under the laws of Alaska a tax is levied on certain fishery products and apparatus, and it is payable annually to the treasurer of Alaska. On May 11, 1921, the treasurer furnished a statement showing the collections as made to that date for the fiscal year ending December 31, 1920. As compared with collections for 1919, the revenues of the Territory fell off \$51,901.14, which amount is almost covered, however, by delinquent taxes for 1920.

FISHERY LICENSE TAXES COLLECTED BY TERRITORY FOR FISCAL YEAR ENDED DEC. 31, 1920.

| Schedule. | Division No. 1. | Division No. 2. | Division No. 3. | Total. |
|---|-----------------|-----------------|-----------------|--------------|
| Salmon canneries..... | \$52,460.26 | \$1,260.94 | \$88,474.61 | \$142,195.81 |
| Herring canneries..... | 71.95 | | .10 | 72.05 |
| Clam canneries..... | 3.58 | | 58.48 | 62.06 |
| Salteries and mild-cure plants..... | 923.73 | 123.25 | 4,625.14 | 5,672.12 |
| Fish traps..... | 55,800.00 | | 23,500.00 | 79,300.00 |
| Fish-oil works and fertilizer and fish-meal plants..... | 18,199.73 | | 1,168.00 | 19,287.73 |
| Cold-storage plants..... | 1,500.00 | | 510.00 | 2,010.00 |
| Whale-oil plants..... | | | 100.00 | 100.00 |
| Total..... | 128,879.25 | 1,384.19 | 118,436.33 | 248,699.77 |
| Additional tax ¹ | | | | 700.66 |
| Delinquent whale products tax..... | | | | 21,696.00 |
| Estimated delinquent canned salmon tax..... | | | | 30,000.00 |
| Grand total..... | | | | 301,096.43 |

¹ Additional tax of 1 per cent of their annual net incomes collected from salmon canneries (not possible to segregate by divisions).

DESTRUCTION OF PREDATORY FISHES IN BRISTOL BAY REGION.

During the season of 1920 the Bureau cooperated with salmon packers in the Bristol Bay region by organizing a force for the destruction of predatory fishes in certain waters of the district. Part of the expenses of the expedition were paid from a fund made up by the fishery companies and the governor of Alaska. Field Superintendent Dennis Winn, of the Bureau's fish-cultural service, was in charge of the work. Mr. Winn's report is as follows:

In Seattle equipment was purchased and the services secured of J. W. Gardner, a practical fish-culturist, of the Bureau of Fisheries; A. T. Loeff, of the College of Fisheries, University of Washington, who has had considerable experience in commercial fishing; and Harry Savage, a practical fisherman. All proved excellent men for the work to which they were assigned. Men and equipment were transported from Seattle on the *Libby Maine*, which vessel arrived at Bristol Bay on May 25, and we were put ashore at Libbyville the same evening.

Our equipment was taken ashore at the cannery of the Naknek Packing Co. the evening of June 4, and the following morning we moved the entire equipment with supplies to the cannery of the Alaska-Portland Packers' Association farther up the Naknek River, where it was divided into three lots, one for each location to be operated. Camps were established on the Upper Naknek River, Lake Aleknagik, and Iliamna Lake. Mr. Loeff was in charge of the crew at Naknek, Mr. Savage at Aleknagik, and Mr. Gardner at Iliamna. Each camp was moved several times in order to facilitate the work, as local conditions and possibilities were recognized.

NAKNEK SECTION.

Mr. Loeff, taking with him his portion of the equipment, one white man and two Indians, was immediately transferred upriver, where camp was established that evening about 2 miles below the foot of the rapids. His operations extended from the rapids to about 5 miles below the camp, near the mouth of Ralph River. But few trout were observed below that point. A spoon troll was used en route to the camp site, and several steelheads and one lake trout were caught, all above Ralph River.

In making a survey of the vicinity we found we were late for the migrating salmon, arriving at the latter end of the period, which extended only through the month of May and early June. Good numbers of lake trout, however, were taken in the vicinity of our camp, these weighing from 6 to 12 pounds, and all had fish in their stomachs—young salmon, smelts, and whitefish. It is safe to

say that this species is as detrimental to the salmon industry as is the Dolly Varden, if not more so. One specimen was taken with two whitefish over 12 inches in length in its stomach without distending it. The trout follow the migrating salmon to tidewater and gradually work back into the lake when the young salmon have passed. We found this species distributed through the entire main river above Ralph River and up through the rapids into the lake, but not in extremely large numbers. Steelhead trout were more abundant in the river, as were also grayling and whitefish, the latter, especially, appearing in great numbers.

After the river was thoroughly cleared in the vicinity of our operations camp was moved to the lake outlet, where fair numbers were taken, but, owing to the difficulties of seining and to the salmon ascending, a survey was made of the entire lake with a view to finding more suitable operating points. Camp was finally located at the mouth of Kidawik Creek, on the south side of the lake near the entrance to the east arm, where good numbers of lake trout and some Dolly Vardens were taken. The lake entrance would be an excellent location when the young salmon are descending early in the season, but none were in evidence at that date, June 17.

Practically all the fish entering Naknek Lake either pass up Kidawik Creek or Simenoffsky River at the extreme head of the east arm. The lake shore, with the exception of a few miles along the south shore, offers no inducement for spawning fish owing to the amount of ashes accumulated from the eruption of 1912 distributed along the shore line. All other tributaries are thickly impregnated with ashes. While our arrival was late and help of little account, about 16,600 pounds were destroyed, mostly lake trout.

Kidawik Creek is an ideal salmon stream with fine spawning bottom its entire length of about 2 miles. It connects Naknek Lake with Toms Lake, which is 12 by 4 miles in extent, the greater portion being clear and suitable for spawning grounds. About midway between the two lakes there is a waterfall from 5 to 8 feet high, over which it would be impossible for fish to ascend during low-water stage. It is a stone shelf of volcanic formation extending clear across the river, and, having no powder, we felt that a cut could be made with steel bars, etc. We therefore secured several stone-cutting gads, a steel bar, top maul, hammer and pick, and, after diverting the flow of water near one side of the stream, a cut was made 10 feet in width, sloping back about 15 feet, through which the fish could easily pass.

The salmon made their appearance in the mouth of the creek July 8, the number increasing gradually. A good run entered July 15, which was the date the cut was complete. There were fair numbers that found and passed through the cut, but the majority worked continuously at the center of the fall, many being injured and floating downstream. As the water rose, some of the fish were noticed passing over the top of the dam, and with high water they had no trouble in passing over. The cut makes it possible for them to ascend at any time. Fishing at this point was conducted in conjunction with the work of making a passageway through the dam. The trout taken were chopped fine and used to bait certain suitable seining points, where the fish gathered in numbers, and a seine was slipped around them.

As this point was the only one where the fish could be observed, owing to the murky water, we endeavored to keep a check on the new arrivals from day to day in order to estimate the approximate escapement. From such observations it is estimated that about 150,000 fish entered the lake. This estimate must of necessity be rough, as the water was so badly discolored. There was no way by which we could intelligently estimate the number entering Simenoffsky River, as the water at that point was thick with ashes, but indications were of less fish than at Kidawik, and an average was accepted of from one-half to two-thirds. This would place the total escapement at the figure mentioned, which we consider as near an average as could be secured with our opportunities.

On two occasions the camp was visited by bears, when all the crew were absent, and the tent was slashed down the side. While bears were observed from time to time in the vicinity, none of the men was ever threatened.

WOOD RIVER SECTION.

On the evening of June 8, accompanied by Mr. Savage and another white man, I left on the Alaska-Portland Packers' Association boat *North King*, en route to Lake Aleknagik. We arrived at Dillingham the morning of the 9th,

where supplies were purchased and the services engaged of two natives to assist Mr. Savage. However, we were forced to discharge these men after three days' service. One native was later secured who qualified and remained to the completion of the work at that point.

Men and equipment were transferred from Dillingham on the Alaska-Portland Packers' Association power boat *Eku* to Lake Aleknagik, where camp was established June 10 at the lake outlet. A survey was made of this lake to determine its possibilities for trout operations. It was learned that the only suitable places lay at the lake outlet and the mouth of the river between Aleknagik and Nerka lakes.

Set and drift gill nets, in connection with seine and troll lines, were used and the early work centered at the lake outlet, where a considerable number of Dolly Vardens were taken, weighing from two to seven pounds each. The stomachs of these fish were all well filled with migrating salmon, Nos. 2½ and 3 in size, 25 or more young salmon being counted in a stomach. The habits of the trout were observed closely. It was noticed that they met the salmon schools at the inlet and outlet of the lake, where the bar drops off into deep water, a certain number of trout accompanying and feeding on the salmon.

In connection with the Dolly Vardens working on the young salmon in deep water, the terns are almost equally severe at the surface. The salmon migrate in enormous schools, making them easy prey for trout, and the work of the latter forces the young salmon to the surface, where the terns take their toll. Large flocks of from 500 to 1,000 were noticed actively feeding whenever a school passed certain points. After several days' operations at the lake outlet the catch of trout became almost negligible, and it was noticed that while the terns were present in large numbers and would become excited and active on sighting a school of young salmon, their success in catching was materially lessened, the fish not coming close enough to the surface. No trout other than Dolly Vardens were taken in this section, and very few under 2 pounds were captured. All averaged 3 and 4 pounds, and specimens weighing 7 pounds were common.

Through the courtesy of Capt. Williams, of the Alaska Packers Association, we were supplied with a tally scow, and, with the assistance of Mr. Daly, of the Alaska-Portland Packers' Association, this scow was towed into the lake. We were comfortably housed and easily moved. When the trout became scarce at the lake outlet the camp was moved to the upper end of the lake, where the scow was placed in the mouth of the river connecting with Nerka Lake. At this point good results were secured, and it was here that the bulk of the trout was taken. It is estimated that from 35,000 to 40,000 pounds of trout were destroyed. Many were diseased, wormy, and emaciated, but always ready to feed.

The migrating season of salmon in this district extends over a period of about three months, and, figuring an average of 15 to 20 migrating salmon for each trout per day—which represents but one feed for the average trout taken—the number of trout destroyed would mean a saving of more yearling salmon than could be handled in any of our hatcheries during a season, not to mention the expense of feeding, etc., and this without taking into consideration the serious depredations of the terns.

Our point of vantage in the scow enabled us to keep a close tally on the adult salmon ascending to the spawning grounds, together with the proportion of loss from fungus growth, due to gill-net injuries. No large run of salmon was ever observed ascending, but a steady line was noticed from July 5 to July 20, gradually tapering off to small numbers at the date of our departure, July 28. Some were noted ascending prior to July 5, but in negligible numbers. As consistent a check as possible was kept on the ascending fish. The salmon came along the shore of the lake, entered the river, and passed into the strong river current in the rear of our scow, where the current and scow created smooth water. Dolly Varden trout as large as the salmon were noticed passing upstream with the latter in a ratio of about 2 to 4 per cent. As no small trout were taken throughout the season it is believed that all spawn in the upper lakes. Those taken by us were principally sea-run fish. It was impossible to use gill nets without injury to the salmon, and the trout operating in deep water made it necessary to devise some other means of capture. Mr. Savage devised a mold in the shape of a fish, and this was poured full of lead over the stem of a large, long-shank fishhook, which was used as a troll and

fished among the migrating salmon. With this crude device two men succeeded in taking 1½ tons of trout in one day. As fishing continued the numbers taken gradually decreased several hundred pounds each day to the time of our departure, when the best capture possible was from 300 to 1,000 pounds per day.

A check was made from time to time, in 5-minute periods, on the numbers of salmon ascending during the height of the run, and it was estimated that about 400,000 fish passed upstream during the period of 20 days. This constituted the run, figuring a steady escapement during the whole 24-hour day. This figure, while not absolutely correct, we feel is as close an estimate as can be made under the circumstances.

The salmon afflicted with fungus were closely checked by myself and each employee individually, and we estimated that 5 per cent unable to swim the current in the river would die in the lower lake in a very short time. A wound caused by gill nets in salt water rapidly becomes covered with fungus after the fish enters fresh water. When the fish is badly cut the wound putrefies rapidly, and on arrival at the head of the first lake there will be a circle of fungus one-half inch or more in depth and several inches wide around the body of the fish. Another 5 per cent were noticed with numerous gill-net marks around the body, but in these the fungus was not in an advanced stage. However, while these fish have strength to ascend the river, I am positive that few, if any, ever reach the spawning stage.

KVICHAK AND ILIAMNA SECTION.

It was planned to operate early on the Kvichak River, but owing to the impossibility of securing help and an accident to one of our boats en route, which was repaired at the cannery of the Alaska-Portland Packers' Association, that plan was necessarily abandoned.

For various reasons it was impossible for Mr. Gardner, who had his equipment assembled at Naknek, to reach the Iliamna district before June 27, and at that date the water was extremely high in the streams with occasional floods overflowing the banks. Very little help was possible, but every effort was made with gill nets; seines could not be used owing to the high water. Good work was accomplished by Mr. Gardner under discouraging conditions.

The writer divided his time between the Wood River and Naknek fields until it was necessary for employees at those points to discontinue work, owing to the departure of cannery boats on which they had passage to the States; then he proceeded to Iliamna, arriving August 10. On the Iliamna River, where our first camp was established, but few large trout were taken, and those mostly at the mouth of the river in the lake. All taken here were Dolly Vardens, with the exception of a few steelhead trout and whitefish. The high water had the effect of scattering the schools and but small numbers were noticed gathering in the pools. The trout, unlike those captured in other localities, were long and slender, which made it impossible to gill many in our nets, and, moreover, the ascent of the salmon necessitated the removal of the nets from the water so as to prevent injuring the ascending salmon.

As the water receded the trout were noticed schooling in the eddies. Traps were improvised, about 5 feet long and 2 feet in diameter, from wooden hoops covered with chicken wire, with an opening in one end similar to the opening in lobster pots. These traps were baited and set in the pools where they caught many thousand fish. In the first one set we took 150 fish in two hours. Many worked through the wire mesh, necessitating doubling the wire screen, thus making the mesh smaller, and no further trouble was experienced. These bait traps have the advantage of catching the predatory fish without in any way attracting or interfering with the salmon. They can also be fished in any water and are efficient up to the time of active spawning.

The people in the vicinity were impressed with these traps and wished to use this method in their own fishing. Therefore, on our departure, we distributed the traps on hand and supplied the other residents with material to make one or two each.

After the pools in the vicinity were cleared of trout, which work was accomplished in short order without interfering with the salmon, it became necessary to seek new locations for operations, and the near-by creeks and rivers were examined with this end in view, and also to obtain all salmon data possible.

In accordance with previous plans, we arranged to proceed to Lake Clark, arriving at the portage between Iliamna Lake and Newhalen River on August

21, where we were storm bound for several days. Supplies and equipment were packed over the portage mainly by myself and assistants, as the Indian packers who perform this kind of work are absolutely undependable, especially as they had considerable money from the summer's work at the canneries, and most of their time was occupied in celebrating. We proceeded upriver en route to Lake Clark on August 28. We learned from natives and prospectors that no Dolly Varden trout are ever taken in Lake Clark, and that there is but one stream in that locality which is inhabited by this species, namely, Kegik Creek.

A thorough survey was made of the entire lake and tributaries, our party passing up the east shore and returning on the opposite side. No trout in quantities were observed, and the possibilities of stream spawning were found to be very limited. It was noticed that the salmon spawn earliest near the outlet of the lake and later as they proceed up the lake. The prospectors and natives were fishing the mouths of the creeks and also directly on the spawning grounds preparing dog feed. Streams were visited in the following order:

Tazimina River is an ideal salmon stream with suitable sloughs for spawning red salmon, but not more than 50 were noticed. A high waterfall about 5 miles from the mouth blocks the ascent of fish.

Tarnalia River is a good stream but contained no salmon. We were advised by prospectors living at its mouth that few salmon ever enter, even in good years. There are falls about 4 miles up and no fish above.

Current Creek is a good spawning stream for the first mile, but unsuitable farther up. It contained no fish.

A small creek at the head of Little Lake Clark could accommodate fair numbers, which are in evidence in good years, but none have appeared for the last two seasons.

Big River, at the junction of Big and Little Lake Clark, is the largest stream tributary to the lake. It is glacial fed and few salmon ever enter.

Portage Creek is small, with no possibilities.

Kegik Creek is a fair-sized stream with good possibilities. It has a lake at its head and is recognized as the best salmon stream in that locality, the fish ascending into the lake. A trip was made to the lake and but few salmon noticed, none being found in the small tributaries at its head which are thoroughly suitable for spawning. I was advised by prospectors in the vicinity that some spawning red salmon were noticed in the lake in December and spawned-out fish still active in January of some years, which would indicate an extremely late run.

Chulitna River has no salmon possibilities. It is a shallow river and heads in a marsh containing large numbers of pike.

Practically all the salmon spawn along the shore of the lake and nearly the entire shore is suitable. Many miles of ideal spawning grounds were noticed along the lake shore. The Indian fish villages, now deserted, scattered along gave positive evidence as to the best spawning locations in former years. Lake trout, especially during the spring months, are numerous and easily taken; specimens reported weighing 40 pounds or more were common. Very little use is ever made of them by the natives, and only in emergency cases are they ever considered. As our time was limited and lake trout were not abundant, we continued back to Iliamna and finished the season with a survey of that lake, with the exception of the west shore, which was too dangerous at that time of year to undertake in a small boat.

The Newhalen River, which connects Iliamna Lake and Lake Clark, has a series of falls and rapids about 2 miles from its mouth, but these are not of sufficient size to hinder the ascent of the fish. The formation, however, renders it easy for the Indians to catch their supply with large hooks on the end of long poles, as the fish must of necessity pass through certain small channels between the rocks. The rapids are about 500 yards long, passing through narrow channels at the upper end and widening to about 300 feet in rapids below, which end in a further widening of the river to about one-half mile. This portion of the river is shallow for about one-quarter of a mile, with ideal spawning bottom, on which some fish were spawning. The major portion of the fish taken by the natives in this locality were captured either in the rapids or on these spawning grounds.

The channel between the river and Iliamna Lake is about 200 yards wide and broadens immediately on entering the river to about one-half mile. This channel

would be an ideal place for the capture of trout with any kind of gear through the spring months.

A good run of salmon was found in Kokhonak Creek, with the usual native family catching them on the spawning beds and drying them as food for the family and dogs. Here we captured a number of steelhead trout in nets, and great numbers were noticed on the beds with salmon, feeding on their eggs. No Dolly Vardens were taken or seen. A trip was made to the lake at the head of the stream, a distance of 6 miles, and it was observed that the stream was well seeded the entire way. The stomachs of the fish taken at this point were filled with decomposed salmon and spawn, and on account of the unlimited supply our bait traps did not appeal.

All streams in Kokhonak Bay were visited, but no fish were noticed in any streams other than Kokhonak Creek and Kokhonak River. A fall 20 feet high in the mouth of Kokhonak River prevents the ascent of fish. From 400 to 500 red salmon were observed endeavoring to pass over this obstruction, but they could not proceed over halfway. It was believed that after being unsuccessful in negotiating the falls they would drop back and spawn. After careful search they were located spawning about 100 feet from the falls, close to a straight rock bluff, in 9 feet of water, and between large bowlders where there were suitable gravel spots. Some lingcod and steelhead trout were observed working in the beds for eggs, and each specimen taken had salmon eggs in its stomach. An efficient fishway can be installed at small expense, providing it is undertaken in the spring, when the water is low. Its installation would open miles of perfect spawning area in the river, and would also permit the fish to pass up as far as Kokhonak Lake. This river is one of the best streams for salmon tributary to Iliamna Lake.

On the Iliamna River trips of observation were made about 12 miles upstream, the first on August 14, when not over 1,000 salmon were seen on the beds; on the second trip, September 17, no salmon were noticed in localities visited in August, but about 500 were found spawning 4 miles from camp. These represented the entire run in Iliamna River for the season. There was always a sprinkling of Dolly Vardens with the salmon, some of them spawning, but they were so scattered as to render capture in any numbers impossible.

Pile River was not visited, but the natives reported no fish there.

A fair run of fish entered Chekok River, from which the majority of the natives in the Iliamna River district obtained most of their fish supply.

The last few days in the field were spent at Iliamna, where we set bait traps and caught several hundred Dolly Vardens, thereby again clearing the pools.

SUMMARY.

Our work was severely handicapped owing to late arrival, the impossibility of securing suitable help, and the necessity of familiarizing ourselves with conditions, each locality having a distinct problem to solve in the capture of trout. We were compelled to pay top wages for native help, and most of the natives were worthless, necessitating their discharge at the earliest moment possible without embarrassment to the work. At no time was suitable help available, except at Iliamna late in the season after the canneries had closed. Our equipment, too, was inadequate; while we expected that gill nets of 3-inch and 3½-inch mesh would be suitable, we found the trout usually too large to gill.

Our experience this year will enable us to wage an extensive and aggressive campaign another season. At Naknek the work can be best accomplished in the early spring months, or up to the time salmon enter the stream. After this, if desirable, some of the operators could be used as stream watchmen through the cannery season. In the Aleknagik Lake section excellent results could be obtained throughout the entire season, or until the canneries close, necessitating departure. Good work can be accomplished in the Iliamna district up to the period of spawning, or the middle of August.

The salmon run was spasmodic in all but the Wood River section, but at no time were there indications of an abundance of salmon in any portion of the districts operated. While the escapement into Wood and Naknek Rivers was greater than that of the previous year, a greatly insufficient number reached the spawning grounds to insure a normal pack and allow sufficient escapement for the future. Our judgment would indicate a totally inadequate supply for even a small year, to say nothing of normal.

In the Kvichak and Iliamna sections the spawning beds were nearly destitute of spawning salmon. I am positive that the storms, which interfered some-

what with the commercial catch, were the salvation of the situation, for if but a slightly increased pack had been made the escapement would have been practically nil and the beds would have been left nearly or wholly bare, with an absolutely discouraging outlook for the future.

We are thoroughly convinced that the predatory fishes, together with the terns mentioned heretofore, constitute one of the most serious menaces facing the salmon industry. In small years, such as 1919 and 1920, they will practically eliminate the cycle runs by their depredations, first on the eggs on the spawning beds, next on the young fish in the first year or two spent in the lakes, and last, but not least, on the migrating fish descending to the ocean. The only hope of curtailing this loss is by waging a constant, aggressive and extensive campaign against these marauders. In the performance of this work a close tally can be kept on the escapement and spawning grounds, which is the only method by which the industry can be advised with any degree of assurance and safety. Our work of extermination this year will surely be of invaluable aid to the future, and its continuance with an enlarged scope will show its value within the next cycle. We also feel at this time that it is one of the greatest hopes for the industrial future of the salmon industry.

RECOMMENDATIONS.

I would respectfully recommend that this work be continued on as extensive a scale as possible for the elimination of predatory fishes and birds.

I recommend the purchase of three power boats of Columbia River type, one for each section operated, with living quarters aboard for three or four people. They would facilitate the work of transferring crews to different localities, and it would not then be necessary to embarrass the different cannery superintendents with requests for the use of a launch when same is needed for cannery work. It would also insure comfortable living and sleeping quarters for the crew and thus eliminate the discomforts of tents and sleeping on the ground, which is nearly impossible in that section during heavy rains. With such a boat many localities could be profitably operated with seines, set and gill nets, and bait traps, necessitating but a small crew at any point of operation. Such a boat would also be of special value to stream watchmen. As efficient work at the different points would cease at about the time the commercial season began, I would suggest that the boats be utilized by some of our men who would be employed as stream watchmen.

Good work can be effectively continued with jigger trolls and bait traps during the period the salmon are running. A small crew can profitably operate as much of this gear as can be efficiently utilized, thus releasing a portion of the crew with the power boats for stream police duty without detriment to the predatory fish work.

Three new 20-foot fishing skiffs are needed, together with several gill nets of large mesh, and material for making a number of bait traps, and three larger and deeper seines, one for each locality. These added to our present equipment will meet any emergency pertaining to our work as outlined.

I would further recommend that employees be engaged in the States and that they reach the different localities in Bristol Bay as early as possible in the spring months. They should be on the first boats reaching the region. Employees should go to the Upper Iliamna by the regular steamship line to Cook Inlet, thence to Iliamna Bay and Iliamna village, arriving about May 1. At that time the water is low and the trout schooling in large numbers. Seines can then be used to advantage, also the bait traps and gill nets. The necessity of reaching Iliamna by Cook Inlet is due to the fact that passage can not be made from Bristol Bay through the lower end of Iliamna Lake before late in the season owing to the ice in that locality.

A fishway should be installed in Kokhonak River.

These recommendations are made to meet conditions as they exist in the sections operated this season, but they can be enlarged in accordance with any plan formulated to broaden the scope of the work.

AFOGNAK RESERVATION.

Historical data have been published year after year showing the establishment of the Afognak Fishery Reservation by presidential proclamation in 1892 and the object that was hoped to be attained

by its creation. From the date of the establishment of the reserve until the spring of 1912 all commercial fishing in Afognak waters was prohibited, but the order was not obeyed and no attempt was made to enforce it. Though those waters were nominally closed to all commercial fishing and the two canneries on Litnik Bay suspended operations and were dismantled and sold, pickling operations were carried on by local parties at the most important streams of the island until 1912, when by departmental order the reservation was opened to the native inhabitants of the region under such terms and conditions as seemed necessary to safeguard the runs of salmon. Although the fishery resources of Afognak were well known, the mere fact that fishing was authorized coincident with the opening of a salmon cannery at Kodiak was sufficient inducement for the entire native population of the island to seek and secure fishing privileges. The legalization of fishing did not, however, increase the supply of salmon in those waters, though on the face of returns that might appear to have been the case. The catch in 1912 was larger than any year since 1892, but it was so for no other reason than that more fishing was done. Yet, on the whole, results were disappointing, and it was early apparent that the island fisheries alone could not support the natives of Afognak. It was further evident, after a few seasons had passed, that the salmon runs would suffer serious depletion if the original scale of operations was allowed to continue. Accordingly a limit was placed on the number of fishermen, who were divided into small gangs, to each of which certain fishing grounds were assigned. Experience taught that where unnecessary numbers of fishermen congregate at one place fishing is much more intensive. This evil was easily corrected by limiting the number of men who might operate at each place and by shortening the fishing season. Authority was therefore given that not to exceed 55 natives were to be licensed to fish in Afognak waters in 1920.

The issuance of licenses was placed in the hands of the superintendent of the fish-cultural station at Afognak until July 10, when William E. Baumann was put in charge of patrol work about the island. He took over the licensing of fishermen for the remainder of the season.

Fishing began May 11 and continued until September 9. Salmon were taken at seven localities, the total catch being 125,538, all species except kings being taken. This catch was sold to the Kodiak Fisheries Co., at Kodiak.

The following table shows the total take of salmon for commercial uses in the Afognak Reservation:

COMMERCIAL CATCH OF SALMON IN WATERS OF AFOGNAK RESERVATION IN 1920.

| Locality. | Coho. | Chum. | Humpback. | Red. | Total. |
|---------------------|--------|-------|-----------|--------|---------|
| Little Afognak..... | 5,128 | ..... | 31,374 | 8,556 | 48,058 |
| Danger Bay..... | 840 | ..... | ..... | ..... | 840 |
| Litnik Bay..... | 6,194 | ..... | ..... | 7 | 6,201 |
| Paramanoff Bay..... | ..... | 35 | 15,385 | 18,009 | 33,429 |
| Seal Bay..... | ..... | ..... | 190 | 11,733 | 11,923 |
| Malina Bay..... | ..... | ..... | 10,995 | 10,728 | 21,723 |
| Izhut Bay..... | ..... | ..... | ..... | 3,364 | 3,364 |
| Total..... | 12,162 | 35 | 60,944 | 52,397 | 125,538 |

As compared with the catch in 1919, cohos increased approximately 16.7 per cent, humpbacks increased 164.2 per cent, and reds declined 50.9 per cent. Chum salmon were taken in negligible quantities, while no kings were obtained.

ALEUTIAN ISLANDS RESERVATION.

The report in regard to permits for fishery operations in the Aleutian Islands Reservation in 1919 stated that at the end of the calendar year 1919 there were 20 permits remaining in effect. Permit No. 18, granted June 22, 1917, to Andrew C. Smith for salmon and cod operations at Unalaska Island, was canceled late in the year. During 1920 the following permits were canceled: No. 21, granted September 19, 1917, to Paul Buckley for whaling operations; No. 35, granted November 6, 1918, to Samuel Applegate for commercial fishery operations at Umnak Island; and No. 41, granted September 6, 1919, to Lars Mikkelsen for cod operations on Unalaska, Akun, and Tigalda Islands. These four permits were canceled upon request of the holders for reissuance in other names. Four additional permits were granted during 1920, which with the 16 remaining in effect made a total of 20 outstanding at the end of the calendar year 1920.

PERMITS FOR FISHERY OPERATIONS IN ALEUTIAN ISLANDS RESERVATION GRANTED DURING CALENDAR YEAR 1920.

| No. | Date. | Grantee. | Location and scope of operations. |
|-----|----------|--------------------------------|---|
| 42 | Apr. 9 | American Whale Products Co. | Whaling plant. Udagak Bay, Unalaska Islands. |
| 43 | Sept. 16 | American Fishing & Packing Co. | Biorki, Rootok, Avatanak, Ugamak, Unalga, and Unalaska Islands. Cod stations. |
| 44 | Oct. 11 | A. C. Goss..... | Umnak Island. Commercial fishery operations; erection of salmon cannery prohibited. |
| 45 | Oct. 23 | Bering Sea Fisheries Co. | Six locations on Unalaska Island, Akun Island, and Tigalda Island. Cod stations. |

Two permits were granted jointly by the Departments of Agriculture and Commerce in connection with certain stock-raising and mining activities within the reservation. Four grazing permits previously granted remained effective.

JOINT PERMITS IN ALEUTIAN ISLANDS RESERVATION GRANTED IN CALENDAR YEAR 1920.

| Date. | Grantee. | Purpose and location. |
|---------|------------------------|---|
| Jan. 14 | L. A. Lavigne..... | To raise sheep and cattle on Unalga Island. |
| Oct. 29 | Alaska Sulphur Co..... | For construction of an aerial tramway for mining operations on Akun Island. |

ANNETTE ISLAND FISHERY RESERVE.

By presidential proclamation of April 28, 1916, Annette Island and neighboring small islands were made a fishery reserve for the exclusive benefit of the Metlakatla Indians then living thereon, and

for such other Indians of Alaska as might desire to establish their homes in the reservation. The Bureau of Education, Department of the Interior, administers the affairs of the reserve for the Indians residing therein.

In 1918 fishing privileges in the reserve were leased to the Annette Island Packing Co. under a five-year contract, which provided that the company should pay to the Metlakatlans a royalty of 1 cent per fish for all salmon taken by traps in the coastal waters of Annette Island and a fee of \$100 for each trap operated, and that all labor in connection with the catching and canning of salmon, except that of a few skilled mechanics, should be performed by the Indians. The company was also to employ the Indians at all common labor required in the maintenance and upkeep of the cannery. The season of 1920 was the third year of operations by the company in accordance with the terms of the contract.

Seven traps were operated by the company, for which a fee of \$700 was paid. The catch of salmon by traps was 967,600, for which the Indians received \$9,676; contract labor in the cannery brought them a return of \$36,298.88, while payments for 75,268 salmon taken by purse seines and for labor on buildings and docks, including material, such as lumber and piling, further increased the income of the Metlakatlans by \$24,391.86. The total disbursement of money to the Indians by the Annette Island Packing Co. was \$71,066.74, or \$18,966.14 less than in 1919.

COPPER RIVER FISHERY.

The importance and peculiar geographical conditions of the Copper River fishery again warrant special mention. In 1920 this fishery produced 946,452 salmon of all species as compared with a catch of 1,307,401 in 1919 and of 869,350 in 1916, the year in which the progenitors of the 1920 run made their appearance.

In all, nine packing companies took salmon from the Copper River in 1920, eight of which carried on fishing in the delta district, while one operated exclusively in the lake and canyon sections. Those operating on the delta were the Canoe Pass Packing Co., Carlisle Packing Co., Eyak River Packing Co., Alaska Sea Food Co., Hoonah Packing Co., Pioneer Packing Co., Hillery-Scott Co., and Hayes-Graham Fish Co. The only operator in the up-river district was F. H. Madden, who packed at the cannery formerly listed under the name of the Abercrombie Packing Co. It is of interest also to record that the Hayes-Graham Fish Co. operated a floating cannery on the delta at the entrance to Pete Dahl Slough.

There were 46,000 fathoms of gill nets used in the delta fishery and 4,227 fathoms in Miles Lake, a total of 50,427 fathoms for the river as a whole. This is a decrease in nets at the delta of 18,800 fathoms, or approximately 28.8 per cent, and an increase at the lake of 977 fathoms of nets, or approximately 30 per cent. Practically no change in the number of dip nets was noted between 1919 and 1920.

The following table shows the catch of salmon by districts and species during the five years from 1916 to 1920, inclusive:

CATCH OF SALMON IN COPPER RIVER FROM 1916 TO 1920, INCLUSIVE.

| District and species. | 1916 | 1917 | 1918 | 1919 | 1920 |
|---------------------------|---------|---------|-----------|-----------|---------|
| Delta district: | | | | | |
| Cohos..... | 79,396 | 55,564 | 36,247 | 24,872 | 55,484 |
| Kings..... | 5,440 | 5,134 | 4,292 | 8,972 | 15,086 |
| Reds..... | 300,157 | 455,001 | 745,522 | 1,096,090 | 700,342 |
| Humpbacks..... | 31,578 | | | | |
| Total..... | 416,571 | 515,699 | 786,061 | 1,129,934 | 770,912 |
| Lake and Canyon district: | | | | | |
| Cohos..... | 36,034 | 36,839 | 25,509 | 15,778 | 18,440 |
| Kings..... | 8,765 | 8,050 | 14,506 | 4,092 | 6,345 |
| Reds..... | 407,980 | 309,324 | 484,607 | 157,597 | 150,755 |
| Total..... | 452,779 | 354,213 | 524,922 | 177,467 | 175,540 |
| Grand total..... | 869,350 | 869,912 | 1,310,983 | 1,307,401 | 946,452 |

On October 5, 1920, a preliminary hearing was held at Cordova, Alaska, to consider the advisability of amending the order of December 20, 1918, limiting or prohibiting fishing in the Copper River, and a further hearing on the same matter was held at Seattle, Wash., on November 18, 1920. As a result of these hearings the order of December 20, 1918, was continued in force until September 1, 1921, on and after which date all commercial fishing in the Copper River, its lakes and tributaries, and within 500 yards of the mouth of its outlets is prohibited. The closing order is given in full on page 11 of this report.

YUKON RIVER FISHERY.

The Carlisle Packing Co. carried on practically all the commercial fishing for salmon for export from the Yukon River in 1920. The cannery was located at Kwiguk Slough, and operations were restricted to the south mouth of the river below the junction of the Clear River, and to the waters of Bering Sea more than 500 yards off the mouth of the Yukon.

The total catch of salmon by this company was 214,122, of which 155,655 were chums and 58,467 were kings. Of these, 105,218 chums and 40,493 kings, or approximately 68 per cent, were taken in outside waters beyond the jurisdiction of the Department. The catch in the river was 50,437 chums and 17,974 kings. The pack consisted of 12,876 cases of chums, 15,961 cases of kings, and 145 tierces and 20 barrels of mild-cured and pickled king salmon. These operations gave employment to 176 whites, 53 natives, and 41 Japanese, or a total of 270 persons. The investment was \$534,000; the value of all products was \$349,356. Fishing apparatus consisted of 2 fish wheels and 12,000 fathoms of gill nets.

During the summer of 1920 the Yukon River was visited by Dr. Charles H. Gilbert, of Stanford University, and Henry O'Malley, field assistant of the Bureau, who made an examination of the river from Dawson, Yukon Territory, to the delta. They collected much information and data regarding the runs of salmon and the number of fish used by the residents of the Yukon Valley. They were accompanied by Inspector Calvin F. Townsend, who gave particular attention to the enforcement of the fishery laws and regulations in that region from the middle of June to the end of July. The Bureau's

boats *Swan* and *Tern* were used in cruising the Yukon and some tributaries. The report by Dr. Gilbert and Mr. O'Malley is published in full elsewhere in this document.

In line with the recommendation in their report that all commercial fishing in the Yukon be suspended, a public hearing was held in Seattle, Wash., on November 23, 1920, to consider the advisability of such action. Satisfactory information was presented at that hearing in support of the opinion generally expressed that commercial fishing for export could not be continued without seriously depleting the runs of salmon and jeopardizing the lives of the native inhabitants of the region and their indispensable dogs. Accordingly the Secretary of Commerce issued an order on December 18, 1920, prohibiting the taking of salmon for other than local use from the Yukon River, its tributaries, and the waters within 500 yards of the mouth thereof after August 31, 1921.

HATCHERIES.

EXTENT OF OPERATIONS.

The two Federal salmon hatcheries in Alaska, one on McDonald Lake, in the southeast district, and the other on Afognak Lake, in the central district, were operated in 1920, except that at the station first named no eggs were collected during the year. In addition, two private hatcheries were operated in southeast Alaska, one a few miles from Loring, owned by the Alaska Packers Association, and the other at Quadra, owned by the Northwestern Fisheries Co. All of these hatcheries were engaged chiefly in the propagation of red salmon.

The Territorial Fish Commission of Alaska also operated a hatchery at Juneau, the collection of eggs being made at two field stations, one of which was on the mainland of Alaska, a few miles north of Juneau, while the other was at Auk Cove, on the north shore of Admiralty Island, about 25 miles southwest of Juneau.

Exclusive of the number collected by the Territorial commission, the total take of red-salmon eggs by the Federal and privately owned hatcheries hereinbefore mentioned was 99,990,000, or 19,070,000 less than the number collected in 1919. This smaller collection is accounted for by the total suspension of operations at the McDonald Lake station, where important repairs to the plant were being made, and also by the washout of retaining racks at the Afognak station during the spawning season.

OPERATIONS OF FEDERAL AND PRIVATE HATCHERIES IN ALASKA IN 1920.

| Station. | Red or sockeye salmon eggs taken in 1919. | Red or sockeye salmon liberated in 1919-20. | Red or sockeye salmon eggs taken in 1920. |
|--------------------|---|---|---|
| McDonald Lake..... | 9,752,000 | 9,387,000 | ..... |
| Afognak Lake..... | 179,178,000 | 61,524,000 | 62,300,000 |
| Fortmann..... | 18,420,000 | 17,070,000 | 18,240,000 |
| Quadra..... | 11,710,000 | 11,357,000 | 19,450,000 |
| Total..... | 119,060,000 | 99,338,000 | 99,990,000 |

¹ 7,000,000 eyed eggs transferred to the Federal hatchery at Quinalt, Wash., and 3,000,000 to the State hatchery at Bonneville, Oreg.

HATCHERY REBATES.

Under the law of 1906 for the protection and regulation of the fisheries of Alaska, the owners of privately operated hatcheries in Alaska are exempt from the payment of all taxes and license fees on their catch and pack of salmon at the rate of 40 cents per 1,000 red or king salmon fry liberated, which is equivalent to the tax of 4 cents per case on 10 cases of canned salmon. This rebate is obtained by the operators filing with the clerk of the district court of the judicial division of Alaska in which the hatchery is located an affidavit showing the number of red and king salmon fry planted in the waters of Alaska in the year covered by the affidavit. The clerk of the court then issues certificates to the owners of the hatcheries for the number of fry liberated, and these in turn are accepted by the Government in payment of taxes and licenses as aforesaid.

Rebates due private hatchery operators are shown in the following table:

REBATES CREDITED TO PRIVATE SALMON HATCHERIES DURING FISCAL YEAR ENDED
JUNE 30, 1920.

| Owner. | Location. | Red-salmon fry liber- ated. | Rebate duc. |
|---------------------------------|----------------------|-----------------------------------|----------------|
| Alaska Packers Association..... | Naha Stream..... | 17,070,000 | \$6,828.00 |
| Northwestern Fisheries Co..... | Hugh Smith Lake..... | 11,357,000 | 4,542.80 |
| Total..... | | 28,427,000 | 11,370.80 |

HATCHERY OPERATIONS.

M'DONALD LAKE.

In 1919 a collection of 9,752,000 red-salmon eggs was made at the McDonald Lake station, from which 9,387,000 fry were hatched and planted in contiguous waters. There was a loss of 365,000 eggs and fry, or approximately 3.8 per cent.

No eggs were collected at that station in 1920, owing to the fact that the water-supply pipe line had to be renewed, an entire complement of new hatching troughs provided, and a new foundation put under the hatchery building. As this work could be done satisfactorily only in the summer months, it was necessary to suspend fish-cultural work for the season.

AFOGNAK.

Out of the 79,178,000 red-salmon eggs taken at the Afognak station in 1919, a shipment of 7,000,000 eyed eggs was made to the Bureau's station at Quinault, Wash., and another of 3,000,000 to the Oregon State hatchery at Bonneville. From the eggs remaining there were hatched and liberated in Afognak Lake 61,524,000 fry. The loss was 7,654,000 eggs and fry, or approximately 9.6 per cent.

In 1920 a total of 62,300,000 red-salmon eggs was collected by September 24. Spawn taking was stopped at that time by high water, which damaged the retaining racks and allowed the escape of all un-

spawned salmon, thus materially affecting the possible take of eggs. The run of salmon was reported as being equal to that of 1919, or sufficient to have yielded a quantity of eggs far in excess of the capacity of the hatchery.

FORTMANN.

The Alaska Packers Association operated the hatchery at Heckman Lake, on Revillagigedo Island, as heretofore. In 1919 a collection of 18,420,000 red-salmon eggs was made, from which 17,070,000 fry were hatched and planted in the Naha stream system. The loss during incubation was 1,350,000, or approximately 7.3 per cent.

Egg collecting in 1920 began September 4 and ended November 11. In that time 18,240,000 red-salmon eggs were obtained. In addition 360,000 humpback-salmon eggs were also taken.

QUADRA.

The Quadra hatchery on Hugh Smith Lake is owned by the Northwestern Fisheries Co. Out of the 11,710,000 red-salmon eggs taken in 1919, there were hatched and liberated 11,357,000 fry, the loss being 353,000, or 3 per cent.

Egg taking in 1920 began August 5 and ended October 28, resulting in a collection of 19,450,000, an increase of more than 71 per cent over 1919.

JUNEAU.

The Alaska Territorial Fish Commission operates a hatchery in a rented building at Juneau. The plant appears to be modern and is equipped with concrete troughs. No ponds, however, are available for rearing purposes. The commission began this work in 1919, and in 1920 the capacity of the hatchery was enlarged to handle 10,000,000 salmon eggs.

In 1919 the commission reported the collection of salmon eggs as follows: Cohos, 10,540,000; chums, 3,425,000; and humpback, 890,000—a total of 14,855,000. Of the resulting product, 6,815,000 were distributed as eyed eggs and 5,250,000 as fertilized eggs, while 2,110,000 were distributed as fry. The loss in eyeing and hatching was 680,000. The distributions occurred in waters on Admiralty and Baranof Islands and streams on the mainland in the Juneau region.

In 1920 the commission reported a collection of 17,020,000 salmon eggs, of which 6,460,000 were cohos, 5,250,000 chums, 4,640,000 humpbacks, and 670,000 reds. Of these, irrespective of species, 4,885,000 were planted as eyed eggs, 6,500,000 as fertilized eggs, and 2,919,000 were distributed as fry. The loss of eggs held through the period of incubation was 846,000, or a little more than 8 per cent. By species, these distributions were cohos, 5,730,000; chums, 5,000,000; humpbacks, 3,410,000; and reds, 134,000. The fry remaining in the hatchery totaled 1,900,000.

GENERAL STATISTICS OF THE FISHERIES IN 1920.

The total investment in the fisheries of Alaska in 1920 was \$70,986,221, or \$3,195,339 less than in 1919. Approximately 89 per cent

of this amount was invested in the salmon industry. Employment was given to 27,482 persons or 1,052 less than in 1919. The total value of the products in 1920 was \$41,492,124, a decrease of \$8,789,940, or approximately 17½ per cent. The important factor in this reduced production was the smaller pack of salmon in southeast Alaska.

SUMMARY OF INVESTMENTS IN THE FISHERIES OF ALASKA IN 1920.

| Industries. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|-------------------------|-------------------|-----------------|-----------------|--------------|
| Salmon canning..... | \$30,153,798 | \$14,058,952 | \$18,337,977 | \$62,550,727 |
| Salmon mild-curing..... | 213,632 | | | 213,632 |
| Salmon pickling..... | 9,800 | 560 | 288,321 | 298,681 |
| Salmon dry salting..... | | | 45,232 | 45,232 |
| Salmon by-products..... | 375,127 | | | 375,127 |
| Halibut fishery..... | 2,270,722 | | | 2,270,722 |
| Herring fishery..... | 443,346 | 949,006 | 4,260 | 1,396,612 |
| Cod fishery..... | | 1,639,453 | 418,275 | 2,057,728 |
| Whale fishery..... | 535,700 | 88,904 | 1,076,207 | 1,700,810 |
| Crab fishery..... | 550 | 200 | | 750 |
| Shrimp fishery..... | 76,100 | | | 76,100 |
| Total..... | 34,078,784 | 16,737,075 | 20,170,362 | 70,986,221 |

SUMMARY OF PERSONS ENGAGED IN THE FISHERIES OF ALASKA IN 1920.

| Races. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|--------------------|-------------------|-----------------|-----------------|--------|
| Whites..... | 6,629 | 3,648 | 5,775 | 16,052 |
| Natives..... | 2,442 | 874 | 417 | 3,733 |
| Chinese..... | 1,115 | 563 | 691 | 2,369 |
| Japanese..... | 1,071 | 273 | 101 | 1,445 |
| Filipinos..... | 862 | 358 | 367 | 1,587 |
| Mexicans..... | 278 | 174 | 1,227 | 1,679 |
| Negroes..... | 24 | 53 | 230 | 307 |
| Miscellaneous..... | 184 | 19 | 107 | 310 |
| Total..... | 12,605 | 5,962 | 8,915 | 27,482 |

SUMMARY OF PRODUCTS OF THE ALASKAN FISHERIES IN 1920.

| Products. | Quantity. | Value. |
|--------------------------------------|-----------|--------------|
| Salmon: | | |
| Canned.....cases.. | 4,429,463 | \$35,602,800 |
| Mild-cured.....pounds.. | 1,857,600 | 364,219 |
| Pickled.....do..... | 964,400 | 104,873 |
| Frozen.....do..... | 1,916,595 | 161,143 |
| Fresh.....do..... | 3,248,081 | 263,264 |
| Dry salted.....do..... | 224,840 | 37,535 |
| Dried and smoked.....do..... | 20,000 | 3,250 |
| By-products, oil.....gallons.. | 39,052 | 16,370 |
| By-products, fertilizer.....pounds.. | 1,778,000 | 88,382 |
| Halibut: | | |
| Fresh.....do..... | 7,506,763 | 1,034,380 |
| Frozen.....do..... | 7,788,017 | 692,343 |
| Canned.....do..... | 720 | 75 |
| Herring: | | |
| Canned, 1-pound cans.....cases.. | 3,602 | 28,980 |
| Fresh for food.....pounds.. | 2,400 | 105 |
| Frozen for bait.....do..... | 1,559,100 | 21,167 |
| Frozen for bait.....do..... | 2,525,700 | 20,027 |
| Pickled, Scotch cure.....do..... | 8,223,490 | 490,485 |
| Pickled, spiced.....do..... | 8,000 | 400 |
| Pickled, Norwegian cure.....do..... | 344,619 | 22,199 |
| Fertilizer.....do..... | 6,078,600 | 316,161 |
| Oil.....gallons.. | 681,067 | 404,090 |

SUMMARY OF PRODUCTS OF THE ALASKAN FISHERIES IN 1920—Continued.

| Products. | Quantity. | Value. |
|--------------------------------------|------------|-------------------------|
| Cod: | | |
| Dry salted.....pounds.. | 10,837,321 | \$932,110 |
| Pickled.....do..... | 1,895,638 | 181,647 |
| Fresh.....do..... | 565 | 23 |
| Stockfish.....do..... | 12,775 | 2,300 |
| Tongues.....do..... | 17,600 | 1,384 |
| Whales: | | |
| Oil.....gallons.. | 765,309 | 304,256 |
| Sperm oil.....do..... | 343,611 | 131,783 |
| Fertilizer, meat.....pounds.. | 2,436,000 | 101,105 |
| Fertilizer, bone.....do..... | 754,000 | 18,815 |
| Bone.....do..... | 17,484 | 6,118 |
| Ivory.....do..... | 750 | 225 |
| Clams.....cases.. | 6,833 | 46,812 |
| Trout: | | |
| Canned.....do..... | 470 | 2,384 |
| Fresh and frozen.....pounds.. | 74,470 | 11,128 |
| Pickled.....do..... | 2,000 | 150 |
| Sablefish.....do..... | 584,251 | 28,544 |
| Crabs: | | |
| Canned.....cases.. | 70 | 1,050 |
| Fresh.....pounds.. | 6,350 | 690 |
| Shrimps.....do..... | 112,045 | 49,123 |
| Miscellaneous fresh fish.....do..... | 11,073 | 229 |
| Total..... | | ¹ 41,492,124 |

¹ These figures represent the value of the manufactured product. It is estimated that the value of the catch to the fishermen is approximately \$12,000,000.

SALMON INDUSTRY.

The most prominent features of the salmon industry growing out of the operations of 1920 are (1) the continued falling off in the catch of salmon in southeast Alaska and (2) the increase in production in both central and western Alaska. But the catch of salmon in any district may not be a sufficient indicator of the condition of the fisheries therein unless considered in connection with the character of fishing activities, the amount of gear used, length of season, and the intensiveness of operations. Nor can an accurate analysis of the condition of the fisheries be made until the position and influence of these factors are determined; and even then there are other factors of less prominence which may have an important bearing on the question, as, for instance, the application of restrictive measures designed to afford more protection to the runs of salmon.

Consideration of certain pack figures in the southeastern district for a number of years back may be of interest. From 1912 to and including 1920 the pack of canned salmon in southeast Alaska did not vary markedly, except from 1916 to 1917 and from 1919 to 1920. The first of these movements was upward, with an increase of more than 1,000,000 cases in 1917; the second marked change occurred in 1920, when there was a decrease of almost 900,000 cases from the previous year. In the three seasons of 1917, 1918, and 1919 the production of salmon in southeast Alaska reached its peak. In 1920 the production may be considered as normal, upon the basis of the general average pack for a series of years, and was not exceeded in the period from 1910 to 1916, inclusive, except in 1915.

In central Alaska there was an increase in the pack of all species of salmon except chums, and the total catch of salmon in that dis-

trict in 1920 has been exceeded but once, and then in 1918, when the necessities of war seemed to demand the largest possible output.

Results in the Bristol Bay district of western Alaska show an improvement over 1919. To a large extent the increased pack was due to a much larger run of salmon in the Port Moller region than for several years. The pack in other parts of western Alaska, particularly the Yukon and Kuskokwim Rivers, was less than in 1919.

SALMON CATCH AND FORMS OF GEAR.

Approximately 99 per cent of the commercial catch of salmon in Alaska in 1920 was made by seines, gill nets, and pound nets, while less than 1 per cent was taken with dip nets, lines, and wheels. Records show that 712 seines were used in 1920, the total length of which was 117,111 fathoms. This is 88 less than the number operated in 1919, and a decrease of 20,173 fathoms in the total length of seines. Of the number used, southeast Alaska was credited with 510, central Alaska with 189, and western Alaska with 13. There were 88,013 fathoms of seine webbing used in southeast Alaska, and the average length of each seine was 172 fathoms; in central Alaska 25,698 fathoms were used, the average per seine being 136 fathoms; in western Alaska 3,400 fathoms were operated, with an average of 261 fathoms per seine.

Statistics show that 4,597 gill nets, having a total length of 475,214 fathoms, were used in the salmon fisheries of Alaska in 1920. Of this number, 351 nets, or 41,780 fathoms of webbing, were used in southeast Alaska; 1,469 nets, or 89,217 fathoms, were used in central Alaska; and 2,777 nets, or 344,217 fathoms, were operated in western Alaska. This is an increase of 477 gill nets, or 15,277 fathoms, over the number used in 1919, when 4,120 nets, or 459,937 fathoms of webbing, were operated.

Statistics also show that 653 pound nets were operated in the salmon industry in 1920, as compared with 630 in 1919. There were 445 driven traps, a decrease of 39, and 208 floating traps, an increase of 62. Southeast Alaska leads with 287 driven traps, 14 less than in 1919, and 197 floating traps, an increase of 54 over the number used in the preceding season; central Alaska had 150 driven and 11 floating traps, which was, respectively, 22 less and 8 more than the number used in 1919; western Alaska had 8 driven traps, or 3 less than in 1919. The rapidly increasing use of floating traps in southeast and central Alaska and the decreasing use of pile traps in all districts are noteworthy developments of the year.

Considering Alaska as a whole, the number of fathoms of seines used in 1920 was approximately 15 per cent less than in 1919; there was an increase of 3 per cent in the number of fathoms of gill nets and 3 $\frac{3}{4}$ per cent increase in the number of pound nets operated in 1920 over that of 1919.

Of the total catch of salmon in 1920, seines took 26 $\frac{3}{4}$ per cent, gill nets approximately 20 per cent, and pound nets approximately 53 per cent. In 1919 the catch by apparatus was: Seines 36 per cent, gill nets 19 per cent, and pound nets 42 per cent. The change in 1920 was a decrease in catch by seines of 9 $\frac{1}{4}$ per cent and an increase by gill nets of 1 per cent and by pound nets of 11 per cent. The following

table shows the proportionate catch by districts according to the principal kinds of apparatus:

PERCENTAGE OF SALMON CAUGHT IN EACH ALASKA DISTRICT, BY PRINCIPAL FORMS OF APPARATUS.

| Apparatus. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | |
|-----------------|-------------------|------------------|------------------|------------------|------------------|------------------|
| | 1919 | 1920 | 1919 | 1920 | 1919 | 1920 |
| | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
| Seines..... | 46 | 30 | 31 | 34 | 3 | 6 |
| Pound nets..... | 49 | 66 | 50 | 59 | 4 | 8 |
| Gill nets..... | 2 | 2 | 18 | 7 | 92 | 86 |

In 1920 the production of salmon in Alaska was 65,080,539 as compared with 58,172,665 in 1919, an increase of approximately 12 per cent. The decrease in southeastern Alaska was 6,446,220, or a little more than 16 per cent. In central Alaska there was an increase of 9,836,712, or approximately 101 per cent; in the western district the increase was 3,517,382, or approximately 40 per cent. The striking development of the season was the large catch of salmon in central Alaska, it being next to the largest ever recorded for that district, the catch of 1918 alone exceeding it. Considering Alaska as a whole, the 1920 catch shows that in comparison with that of 1919, cohos decreased 538,987, chums decreased 2,065,483, humpbacks increased 6,217,635, kings decreased 192,525, and reds increased 3,487,194.

SALMON TAKEN IN 1920, BY APPARATUS AND SPECIES, FOR EACH GEOGRAPHIC SECTION OF ALASKA.

| Apparatus and species. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|------------------------|-------------------|-----------------|-----------------|------------|
| Seines: | | | | |
| Coho, or silver..... | 284,106 | 85,014 | 2,790 | 371,910 |
| Chum, or keta..... | 4,264,032 | 308,537 | 3,622 | 4,576,191 |
| Humpback, or pink..... | 4,618,516 | 4,362,069 | ..... | 8,980,585 |
| King, or spring..... | 6,540 | 2,187 | 8,257 | 16,984 |
| Red, or sockeye..... | 795,631 | 1,864,565 | 761,682 | 3,421,878 |
| Total..... | 9,968,825 | 6,622,372 | 776,351 | 17,367,548 |
| Gill nets: | | | | |
| Coho, or silver..... | 163,521 | 130,211 | 160,125 | 453,857 |
| Chum, or keta..... | 60,243 | 6,002 | 581,470 | 647,715 |
| Humpback, or pink..... | 73,898 | 74,940 | 937,335 | 1,086,173 |
| King, or spring..... | 60,295 | 22,320 | 189,252 | 271,867 |
| Red, or sockeye..... | 392,882 | 1,113,349 | 8,787,947 | 10,294,178 |
| Total..... | 750,839 | 1,346,822 | 10,656,129 | 12,753,790 |
| Pound nets: | | | | |
| Coho, or silver..... | 552,972 | 445,828 | 6,380 | 1,005,180 |
| Chum, or keta..... | 3,684,559 | 1,163,062 | 42,110 | 4,889,731 |
| Humpback, or pink..... | 16,232,881 | 5,546,058 | 266,914 | 22,045,853 |
| King, or spring..... | 54,080 | 48,550 | 11,816 | 114,446 |
| Red, or sockeye..... | 1,441,224 | 4,268,363 | 619,867 | 6,359,454 |
| Total..... | 21,965,716 | 11,471,861 | 977,087 | 34,414,664 |
| Lines: | | | | |
| Coho, or silver..... | 44,710 | ..... | ..... | 44,710 |
| King, or spring..... | 366,510 | ..... | ..... | 366,510 |
| Total..... | 411,220 | ..... | ..... | 411,220 |

SALMON TAKEN IN 1920, BY APPARATUS AND SPECIES, FOR EACH GEOGRAPHIC SECTION OF ALASKA—Continued.

| Apparatus and species. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|----------------------------|-------------------|-----------------|-----------------|------------|
| Dip nets: | | | | |
| Coho, or silver..... | | 15,202 | | 15,202 |
| King, or spring..... | | 5,660 | | 5,660 |
| Red, or sockeye..... | | 112,415 | | 112,415 |
| Total..... | | 133,277 | | 133,277 |
| Wheels: Chum, or keta..... | 40 | | | 40 |
| Total: | | | | |
| Coho, or silver..... | 1,045,309 | 676,255 | 169,295 | 1,890,859 |
| Chum, or keta..... | 8,008,874 | 1,477,601 | 627,202 | 10,113,677 |
| Humpback, or pink..... | 20,925,295 | 9,983,067 | 1,204,249 | 32,112,611 |
| King, or spring..... | 487,425 | 78,717 | 209,325 | 775,467 |
| Red, or sockeye..... | 2,629,737 | 7,358,692 | 10,199,496 | 20,187,925 |
| Grand total..... | 33,096,640 | 19,574,332 | 12,409,567 | 65,080,539 |

SALMON CANNING.

CHANGES IN CANNERIES.

Three changes occurred in the ownership of canneries in Alaska in 1920. The plant of the Tee Harbor Packing Co., at Tee Harbor, was purchased by the Alaska Pacific Fisheries; the Pavlof Harbor Packing Co. acquired the cannery of the Alaska Packing & Navigation Co. at Pavlof Harbor; the Tenakee Fisheries Co. transferred its plant at Tenakee to the Standard Salmon Packers (Inc.); and the Sockeye Salmon Co. leased its cannery on Isanotski Strait to P. E. Harris & Co. The Everett Packing Co. operated its cannery at Herendeen Bay in the interest of the Herendeen Bay Consolidated Canneries. The Thlinket Packing Co. changed its name to the Thlinket Packing Corporation.

NEW CANNERIES.¹

There were 16 new salmon canneries in Alaska in 1920, 8 of which were opened and operated in southeast Alaska.

In the central district seven new canneries were operated in 1920.

In western Alaska one new cannery, which had been constructed by the Alaska Packers Association in 1919, was put in operation in 1920.

In addition to these plants Robert J. Peratovich put up a small pack by hand at Bayview, Prince of Wales Island, and W. J. O'Connor packed a few cases on the Yukon River delta.

CANNERIES NOT OPERATED.

There were 10 idle canneries in Alaska in 1920, of which 5 were in southeast Alaska, 2 in central, and 3 in western Alaska. The cannery of the Fidalgo Island Packing Co., at Herendeen Bay, was

¹ New canneries are indicated by an asterisk (*) in the table on page 50.

dismantled and will not be operated again. The inactive plants were owned and located as follows:

| | |
|---|-----------------|
| Alaska Fish Co..... | Waterfall. |
| Cape Fanshaw Fish & Packing Co. (Inc.)..... | Cape Fanshaw. |
| Columbia Salmon Co..... | Craig. |
| Southern Alaska Canning Co..... | Quadra Bay. |
| | Hunter Bay. |
| Northwestern Fisheries Co..... | Orca. |
| | Seldovia. |
| Nelson Lagoon Packing Co..... | Nelson Lagoon. |
| Phoenix Packing Co..... | Herendeen Bay. |
| Midnight Sun Packing Co..... | Kotzebue Sound. |

TOTAL CANNERIES OPERATED.

There were 146 salmon canneries operated in Alaska in 1920, as compared with 134 in 1919, of which 82 were located in southeast Alaska, 36 in central Alaska, and 28 in western Alaska. This is an increase of six in both the southeastern and central districts, while the number in western Alaska remains unchanged.

COMPANIES CANNING SALMON IN ALASKA, NUMBER AND LOCATION OF CANNERIES OPERATED, AND NUMBER OF POUND NETS OWNED BY EACH, 1920.

[New canneries indicated by (*).]

| Company. | Canneries. | | Pound nets. |
|---------------------------------------|--------------|------------------------|----------------|
| | Num- ber. | Location. | |
| Southeast Alaska: | | | |
| Ainsworth-Dunn Co..... | 1 | Floating *..... | 120 |
| Alaska Herring & Sardine Co..... | 1 | Port Walter..... | 29 |
| | | Chomley..... | 16 |
| Alaska Pacific Fisheries..... | 3 | Tee Harbor..... | 413 |
| | | Yes Bay..... | 11 |
| | | Loring..... | 68 |
| Alaska Packers Association..... | 2 | Wrangell..... | |
| Alaska Salmon & Herring Packers..... | 1 | Tyce..... | |
| Alaska Sanitary Packing Co..... | 2 | Cape Fanshaw..... | 5 |
| | | Wrangell..... | |
| Alaska Union Fisheries (Inc.)..... | 1 | Port Conclusion *..... | 72 |
| American Packing Co..... | 1 | Juneau..... | 78 |
| Anacortes Fisheries Co..... | 2 | Kasaan..... | 3 |
| | | Shakan..... | 7 |
| Annette Island Packing Co..... | 1 | Metlakatla..... | 12 |
| Astoria & Puget Sound Canning Co..... | 1 | Excursion Inlet..... | 6 |
| Auk Bay Salmon Canning Co..... | 1 | Auk Bay..... | 1 |
| Baranof Packing Co..... | 1 | Red Bluff Bay..... | 2 |
| F. C. Barnes Co..... | 1 | Lake Bay..... | 85 |
| Beaulaire Packing Co..... | 1 | Port Beaulere..... | 96 |
| Beegle Packing Co..... | 1 | Ketchikan..... | |
| Burnett Inlet Packing Co..... | 1 | Burnett Inlet..... | |
| Cape Flattery Fisheries Co..... | 1 | Floating *..... | 95 |
| John L. Carlson & Co..... | 1 | Auk Bay..... | 91 |
| Chilkat Packing Co..... | 1 | Haines *..... | 88 |
| Columbia Salmon Co..... | 1 | Tenakee Inlet..... | 98 |
| Deep Sea Salmon Co..... | 2 | Port Arm..... | 25 |
| | | Port Althorp..... | |
| Douglas Island Packing Co..... | 1 | Douglas..... | |
| Fidalgo Island Packing Co..... | 2 | Ketchikan..... | 12 |
| | | Pillar Bay..... | |
| George Inlet Packing Co..... | 1 | George Inlet..... | 2 |
| Haines Packing Co..... | 1 | Letinkof Cove..... | |
| P. E. Harris & Co..... | 1 | Hawk Inlet..... | 1019 |
| Hidden Inlet Canning Co..... | 2 | Hidden Inlet..... | 35 |
| | | Hood Bay..... | 4 |
| Hood Bay Packing Co..... | 1 | Hood Bay..... | 4 |

¹ Seventeen floating.

² Four floating.

³ Three floating

⁴ Eight floating.

⁵ Six floating.

⁶ Seven floating.

⁷ One floating.

⁸ Two floating.

⁹ All floating.

¹⁰ Nine floating.

COMPANIES CANNING SALMON IN ALASKA, NUMBER AND LOCATION OF CANNERIES OPERATED, AND NUMBER OF POUND NETS OWNED BY EACH, 1920—Continued.

| Company. | Canneries. | | Pound nets. |
|-------------------------------------|--------------|--------------------|----------------|
| | Num- ber. | Location. | |
| Southeast Alaska—Continued. | | | |
| Hoonah Packing Co. | 2 | Gambier Bay | 115 |
| G. W. Hume Co. | 2 | Hoonah | 213 |
| Karheen Packing Co. | 2 | Nakat Harbor | 6 |
| Ketchikan Packing Co. | 1 | Seow Bay | 3 |
| Libby, McNeill & Libby | 1 | Karheen | 5 |
| Marathon Fishing & Packing Co. | 1 | Ketchikan | 2 |
| Mount Baker Packing Co. | 1 | Taku Harbor | 18 |
| Mountain Point Packing Co. | 2 | Yakutat | |
| Mutual Packing Co. | 1 | Cape Fanshaw | 33 |
| Geo. T. Myers & Co. | 1 | Floating * | |
| Northern Packing Co. (Inc.) | 1 | Wrangell Narrows | |
| North Pacific Trading & Packing Co. | 1 | Floating * | |
| | 1 | Chatham | 10 |
| | 1 | Juneau | |
| | 1 | Klawak | 31 |
| | 1 | Dundas Bay | 9 |
| | 4 | Quadra | 7 |
| | | Roe Point | 7 |
| | | Santa Ana | |
| Noyes Island Packing Co. | 1 | Steamboat Bay | |
| Olympic Fisheries Co. | 1 | Floating | |
| Pacific American Fisheries | 1 | Excursion Inlet | 613 |
| Pavlov Harbor Packing Co. | 1 | Pavlov Harbor | |
| Petersburg Packing Corporation | 2 | Petersburg | 613 |
| Point Warde Packing Co. | 1 | Washington Bay | 9 |
| Pure Food Fish Co. | 1 | Point Warde | |
| Pybus Bay Fish & Packing Co. | 1 | Ketchikan | 15 |
| Pyramid Packing Co. | 1 | Pybus Bay | |
| Rovilla Packing Co. | 1 | Sitka | 3 |
| Saborn-Cutting Co. | 1 | Ketchikan * | |
| Sitka Packing Co. | 1 | Kake | 11 |
| J. L. Smiley & Co. | 1 | Sitka | |
| | 1 | Ketchikan | 8 |
| Southern Alaska Canning Co. | 2 | Big Port Walter | |
| Standard Salmon Packers (Inc.) | 1 | Rose Inlet | 10 |
| Starr Collinson Packing Co. | 1 | Tenakee Inlet | 15 |
| Strait Packing Co. | 1 | Mora Sound | 32 |
| E. R. Strand | 1 | Skowl Arm | |
| Sunny Point Packing Co. | 1 | Wrangell Narrows * | |
| Swift Arthur Crosby Co. | 1 | Ketchikan | 8 |
| Thlinket Packing Corporation | 1 | Heeceta Island | 13 |
| Todd Packing Co. | 1 | Funter Bay | 21 |
| Union Bay Fisheries Co. | 1 | Todd | 75 |
| Ward's Cove Packing Co. | 1 | Union Bay | 5 |
| | 1 | Ward Cove | 3 |
| Central Alaska: | | | |
| Alaska Packers Association | 4 | Alitak | 16 |
| | | Chignik | 4 |
| | | Kasilof | 14 |
| | | Larsen Bay | |
| Alaska Sea Food Co. | 1 | Point Whited | 74 |
| Alitak Packing Co. | 1 | Lazy Bay | 4 |
| Arcata Packing Co. | 1 | English Bay * | |
| Bainbridge Fisheries Co. | 1 | Evans Island * | 1 |
| Cutco-Pack Packing Co. | 1 | Shepard Point | 5 |
| Carlisle Packing Co. | 1 | Cordova | 8 |
| Central Alaska Fisheries | 1 | Drier Bay * | 1 |
| Columbia River Packers' Association | 1 | Chignik | 4 |
| Copper River Packing Co. | 1 | McChure Bay | 7 |
| Eyak River Packing Co. | 1 | Eyak River | |
| Fidalgo Island Packing Co. | 1 | Port Graham | 7 |
| P. E. Harris & Co. | 1 | Isanotski Strait | 3 |
| Hayes-Graham Fish Co. | 1 | Floating * | |
| Hillery-Scott Co. | 1 | Cordova | 1 |
| Hoonah Packing Co. | 1 | Bering River | 4 |
| Kadiak Fisheries Co. | 1 | Kodiak | 1 |
| Kenai Packing Co. | 1 | Drier Bay | 2 |
| King Salmon Fisheries Co. | 1 | Unakwik Inlet * | 74 |
| Libby, McNeill & Libby | 1 | Kenai | 13 |
| F. H. Madden | 1 | Abercrombie | |
| Moore Packing Co. | 1 | Orea Inlet | 3 |
| | 1 | One floating. | |
| | 2 | Five floating. | |
| | 3 | All floating. | |
| | 4 | Four floating. | |
| | 5 | Six floating. | |
| | 6 | Three floating. | |
| | 7 | Two floating. | |
| | 8 | Twelve floating. | |

1 One floating.

3 All floating.

5 Six floating.

7 Two floating.

2 Five floating.

4 Four floating.

6 Three floating.

8 Twelve floating.

COMPANIES CANNING SALMON IN ALASKA, NUMBER AND LOCATION OF CANNERIES OPERATED, AND NUMBER OF POUND NETS OWNED BY EACH, 1920—Continued.

| Company. | Canneries. | | Pound nets. |
|---------------------------------------|--------------|---|--------------------------|
| | Num- ber. | Location. | |
| Central Alaska—Continued. | | | |
| Northwestern Fisheries Co. | 3 | Chignik..... Kenai..... Uyak..... | 4 14 7 |
| Pacific American Fisheries. | 2 | Ikatan..... King Cove..... | 7 9 |
| Pioneer Packing Co. | 1 | Cordova..... | 7 |
| San Juan Fishing & Packing Co. | 1 | Seward..... | 2 |
| Shumagin Packing Co. | 1 | Squaw Harbor* | 6 |
| Surf Packing Co. | 1 | Chisik Island..... | 2 |
| Valdez Packing Co. | 1 | Valdez..... | 15 |
| Seldovia Canning Co. | 1 | Seldovia* | 3 |
| Western Alaska: | | | |
| Alaska Packers Association. | 9 | Kvichak River (2)..... Naknek River (3)..... Nushagak River (2)..... Ugagak River..... Ugashik River*..... | 1 |
| Alaska-Portland Packers' Association. | 2 | Naknek..... Nushagak Bay..... | 2 |
| Alaska Salmon Co. | 1 | Wood River..... | |
| Bristol Bay Packing Co. | 1 | Kvichak River..... | |
| Carlisle Packing Co. | 1 | Kwiguk Slough..... | |
| Columbia River Packers' Association. | 1 | Nushagak Bay..... | |
| Everett Packing Co. | 1 | Herendeen Bay..... Ekuk..... Kvichak Bay..... Libbyville..... Lockanok..... Nushagak..... Ugagak River..... | |
| Libby, McNeill & Libby. | 6 | Naknek River..... Naknek River..... Nushagak..... Port Moller..... | 5 |
| Naknek Packing Co. | 1 | Naknek River..... | |
| Northwestern Fisheries Co. | 2 | Nushagak..... | |
| Pacific American Fisheries. | 1 | Port Moller..... | 5 |
| Red Salmon Canning Co. | 2 | Naknek River..... Ugashik River..... | |

* One floating.

LOSSES AND DISASTERS IN THE SALMON-CANNING INDUSTRY.

The loss of property by those interested in the salmon industry of Alaska in 1920 was unusually heavy. Four disastrous fires occurred in the southeastern district. The first fire occurred on May 25, before canning had commenced, and it destroyed the cannery of the Mountain Point Packing Co., on Wrangell Narrows, which with the machinery, fishing gear, and floating equipment was valued at \$60,998. The plant was not rebuilt during the season.

The other three fires occurred in August, and entailed considerably heavier losses, being the cause of the destruction of much larger plants at each of which several thousand cases of salmon had been packed and were stored. All of these canneries were located in the southern part of the southeastern district, and were burned in the same month.

The cannery of the Straits Packing Co., at Skowl Arm, including warehouse and equipment, fishing gear in stock, all other stock, and 4,000 cases of canned salmon, was burned on August 6. The total loss was reported as being \$150,000.

On August 20 practically the entire plant of the Hidden Inlet Canning Co. at Hidden Inlet was destroyed by fire, entailing a loss in buildings, supplies, equipment, and canned salmon of \$217,823.

The burning of the Nakat Inlet cannery of the G. W. Hume Co. occurred on August 28. Buildings and fishing gear valued at \$75,000 were lost.

The Chinese quarters at the Roe Point cannery of the Northwestern Fisheries Co. were burned, at a loss of \$4,635.

The vessel losses in southeastern Alaska aggregated \$35,660, chief of which was that of the barge *Dashing Wave*, owned by Libby, McNeill & Libby, and valued at \$15,000.

A rather heavy loss of fishing apparatus was also reported, which in the aggregate was valued at \$80,288. Of this amount, \$67,238 represented the value of traps that were destroyed.

Property losses in central Alaska amounted to \$22,544, the major part of which consisted of fishing apparatus. In western Alaska losses of property having a total value of \$126,966 were reported, of which \$88,802 was charged under vessels and floating equipment, \$31,664 to fishing apparatus, and \$6,500 to buildings and wharves. The notable item in these losses was that of the ship *Chas. E. Moody*, owned by the Northwestern Fisheries Co., and valued at \$80,000.

In 1920 the total loss of property in the salmon industry throughout Alaska was reported as \$773,914, of which approximately 81 per cent was sustained by operators in the southeastern district. The loss of life in this industry was considerably greater than in 1919. In southeastern Alaska 1 fisherman, 3 shoresmen, and 1 transporter met accidental death; in central Alaska 2 shoresmen and 1 transporter were killed and 2 transporters were drowned; in western Alaska 11 fishermen and 2 shoresmen were drowned and 2 shoresmen were killed.

STATISTICS.

There were operated in Alaska in 1920 a total of 146 salmon canneries, 12 more than in 1919. Several of them were small floating plants. The investment in the salmon-canning industry was \$62,550,727, a decrease of \$3,944,444. There was a decline of \$3,588,093 in southeast Alaska and \$1,517,356 in western Alaska. In central Alaska the investment increased \$1,161,005.

The canning industry gave employment to 24,423 persons, or 1,076 less than in 1919. Whites decreased 345, natives 126, Chinese 401, Japanese 39, and Mexicans 214. Filipinos increased 10, and miscellaneous, including Negroes, 39.

The pack of canned salmon was 4,429,463 cases, valued at \$35,602,800, a decrease of 154,225 cases in the pack and of \$7,662,549 in value of the products of 1920 as compared with those of 1919. This is a decline of approximately $3\frac{1}{2}$ per cent in production and $17\frac{3}{4}$ per cent in value from 1919. These decreases in quantity and value of products are directly and entirely due to the smaller pack in southeast Alaska, as in both the other districts the pack was larger than in 1919. A comparison of the pack in 1920 with that in 1919, by districts, shows that southeast Alaska dropped from 3,119,260 cases to 2,225,011, a decrease of 894,249 cases; central Alaska increased from 771,907 to 1,337,448, a gain of 565,541 cases; and western Alaska

increased from 692,521 to 867,004, an advance of 174,483 cases. A further comparison of the pack by species for 1919 and 1920 in Alaska as a whole shows that cohos decreased from 232,870 to 192,085 cases, a decline of 40,785 cases; chums decreased from 1,365,563 to 1,033,517, a drop of 332,046 cases; humpbacks decreased from 1,611,608 to 1,593,120, a drop of 18,488 cases; kings increased from 95,986 to 110,003, a gain of 14,017 cases; and reds advanced from 1,277,661 to 1,500,738, a gain of 223,077 cases.

INVESTMENT IN THE SALMON-CANNING INDUSTRY IN 1920.

| Item. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|------------------------------------|-------------------|-------------|-----------------|-------------|-----------------|-------------|---------|--------------|
| | No. | Value. | No. | Value. | No. | Value. | No. | Value. |
| Canneries operated.... | 82 | \$6,914,906 | 36 | \$2,832,902 | 28 | \$4,885,074 | 146 | \$14,632,882 |
| Working capital..... | | 10,350,339 | | 4,702,152 | | 3,764,804 | | 18,817,295 |
| Wages paid..... | | 5,635,911 | | 3,337,521 | | 4,567,020 | | 13,540,452 |
| Vessels: | | | | | | | | |
| Power vessels over 5 tons..... | 382 | 2,801,915 | 110 | 1,023,750 | 75 | 1,939,076 | 567 | 5,764,741 |
| Net tonnage..... | 7,405 | | 2,613 | | 7,664 | | 17,682 | |
| Sailing..... | 2 | 65,000 | 7 | 325,199 | 32 | 1,295,300 | 41 | 1,685,499 |
| Net tonnage..... | 3,004 | | 10,788 | | 47,220 | | 61,012 | |
| Barges..... | 1 | 6,377 | | | | | 1 | 6,377 |
| Net tonnage..... | 1,354 | | | | | | 1,354 | |
| Launches, under tonnage..... | 131 | 157,919 | 171 | 180,874 | 42 | 146,801 | 344 | 485,594 |
| Boats, row and sail..... | 1,234 | 106,135 | 915 | 128,720 | 1,538 | 651,074 | 3,687 | 885,929 |
| Lighters, scows, and houseboats.. | 430 | 420,389 | 270 | 288,417 | 197 | 445,910 | 897 | 1,154,716 |
| Pile drivers and pile pullers..... | 68 | 505,491 | 44 | 212,715 | 25 | 85,905 | 137 | 804,111 |
| Apparatus: | | | | | | | | |
| Beach seines..... | 107 | 50,954 | 115 | 47,043 | | | 222 | 97,997 |
| Fathoms..... | 11,643 | | 14,959 | | | | 26,602 | |
| Purse seines..... | 402 | 332,824 | 73 | 40,543 | 13 | 22,700 | 488 | 396,067 |
| Fathoms..... | 76,295 | | 10,689 | | 3,400 | | 90,384 | |
| Gill nets..... | 343 | 65,492 | 1,469 | 140,163 | 2,616 | 499,313 | 4,428 | 704,968 |
| Fathoms..... | 39,455 | | 89,217 | | 332,275 | | 460,947 | |
| Pound nets, driven..... | 285 | 2,157,806 | 150 | 767,083 | 8 | 35,000 | 443 | 2,959,889 |
| Pound nets, float- ing..... | 197 | 582,340 | 11 | 28,511 | | | 208 | 610,851 |
| Dip nets..... | | | 184 | 603 | | | 184 | 603 |
| Lines..... | | | | 2,756 | | | | 2,756 |
| Total..... | | 30,153,798 | | 14,058,952 | | 18,337,977 | | 62,550,727 |

PERSONS ENGAGED IN THE SALMON-CANNING INDUSTRY IN 1920.

| Occupations and races. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|----------------------------------|-------------------|-----------------|-----------------|--------|
| Fishermen: | | | | |
| Whites..... | 1,832 | 1,283 | 2,862 | 5,977 |
| Natives..... | 1,249 | 292 | 75 | 1,616 |
| Miscellaneous ¹ | 74 | | | 74 |
| Total..... | 3,155 | 1,575 | 2,937 | 7,667 |
| Shoresmen: | | | | |
| Whites..... | 2,628 | 1,156 | 2,251 | 6,035 |
| Natives..... | 1,085 | 539 | 227 | 1,851 |
| Chinese..... | 1,115 | 563 | 691 | 2,369 |
| Japanese..... | 1,018 | 273 | 101 | 1,392 |
| Filipinos..... | 862 | 358 | 367 | 1,587 |
| Mexicans..... | 264 | 174 | 1,214 | 1,652 |
| Negroes..... | 24 | 53 | 230 | 307 |
| Miscellaneous ¹ | 59 | 18 | 106 | 183 |
| Total..... | 7,055 | 3,134 | 5,187 | 15,376 |

¹ Koreans, Porto Ricans, Kanakas, etc.

PERSONS ENGAGED IN THE SALMON-CANNING INDUSTRY IN 1920—Continued.

| Occupations and races. | Southeast Alaska. | Central Alaska. | Western Alaska. | Total. |
|----------------------------------|-------------------|-----------------|-----------------|--------|
| Transporters: | | | | |
| Whites..... | 812 | 295 | 204 | 1,311 |
| Natives..... | 17 | 18 | 6 | 41 |
| Miscellaneous ¹ | 26 | 1 | 1 | 28 |
| Total..... | 855 | 314 | 211 | 1,380 |
| Grand total: | | | | |
| Whites..... | 5,272 | 2,734 | 5,317 | 13,323 |
| Natives..... | 2,351 | 849 | 308 | 3,508 |
| Chinese..... | 1,115 | 563 | 691 | 2,369 |
| Japanese..... | 1,018 | 273 | 101 | 1,392 |
| Filipinos..... | 862 | 358 | 367 | 1,587 |
| Mexicans..... | 264 | 174 | 1,214 | 1,652 |
| Negroes..... | 24 | 53 | 230 | 307 |
| Miscellaneous ¹ | 159 | 19 | 107 | 285 |
| Total..... | 11,065 | 5,023 | 8,335 | 24,423 |

¹ Koreans, Porto Ricans, Kanakas, etc.OUTPUT OF CANNED SALMON IN 1920.¹

| Product. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|--------------------|-------------------|------------|-----------------|------------|-----------------|------------|-----------|------------|
| | Cases. | Value. | Cases. | Value. | Cases. | Value. | Cases. | Value. |
| Coho, or silver: | | | | | | | | |
| 1-pound flat..... | 7,602 | \$91,541 | 1,267 | \$14,733 | 46 | \$55 | 8,915 | \$106,832 |
| 1-pound flat..... | 8,395 | 80,295 | 1,314 | 14,454 | 1,037 | 10,997 | 10,746 | 105,746 |
| 1-pound tall..... | 95,951 | 631,599 | 64,660 | 595,230 | 11,813 | 114,463 | 172,424 | 1,541,292 |
| Total..... | 111,948 | 1,003,435 | 67,241 | 624,417 | 12,896 | 126,018 | 192,085 | 1,753,870 |
| Chum, or keta: | | | | | | | | |
| 1-pound flat..... | 53 | 394 | | | | | 53 | 394 |
| 1-pound flat..... | 44,582 | 154,353 | 1,585 | 7,291 | | | 46,167 | 161,644 |
| 1-pound tall..... | 792,480 | 3,298,390 | 141,715 | 620,692 | 53,102 | 255,531 | 987,297 | 4,174,613 |
| Total..... | 837,115 | 3,453,137 | 143,300 | 627,983 | 53,102 | 255,531 | 1,033,517 | 4,336,651 |
| Humpback, or pink: | | | | | | | | |
| 1-pound flat..... | 18,277 | 145,749 | 693 | 5,900 | | | 18,970 | 151,649 |
| 1-pound flat..... | 58,265 | 324,353 | 17,752 | 81,659 | | | 76,017 | 406,012 |
| 1-pound tall..... | 931,095 | 5,112,406 | 498,532 | 2,662,343 | 68,506 | 386,640 | 1,498,133 | 8,161,389 |
| Total..... | 1,007,637 | 5,582,508 | 516,977 | 2,749,902 | 68,506 | 386,640 | 1,593,120 | 8,719,050 |
| King, or spring: | | | | | | | | |
| 1-pound flat..... | 5,203 | 85,533 | 1,922 | 32,942 | 3,071 | 52,812 | 10,196 | 171,287 |
| 1-pound flat..... | 3,011 | 45,344 | 1,857 | 21,677 | 12,821 | 194,872 | 18,319 | 261,893 |
| 1-pound tall..... | 37,316 | 313,552 | 18,769 | 158,435 | 25,403 | 302,061 | 81,488 | 774,048 |
| Total..... | 46,130 | 444,429 | 22,578 | 213,054 | 41,295 | 549,775 | 110,003 | 1,207,228 |
| Red, or sockeye: | | | | | | | | |
| 1-pound flat..... | 46,031 | 847,564 | 43,867 | 773,138 | 11,818 | 226,040 | 101,716 | 1,846,742 |
| 1-pound flat..... | 21,378 | 277,802 | 51,497 | 693,054 | 47,272 | 630,700 | 120,147 | 1,601,556 |
| 1-pound tall..... | 154,772 | 1,776,092 | 491,988 | 6,280,839 | 632,115 | 8,080,772 | 1,278,875 | 16,137,703 |
| Total..... | 222,181 | 2,901,458 | 587,352 | 7,747,031 | 691,205 | 8,937,512 | 1,500,738 | 19,586,001 |
| Grand total..... | 2,225,011 | 13,384,967 | 1,337,418 | 11,962,387 | 867,004 | 10,255,416 | 4,129,463 | 35,602,800 |

¹ Cases containing 1/2-pound cans have been reduced one-half in number, and thus, for the purpose of affording fair comparison, all are put upon the basis of 48 1-pound cans per case.

OUTPUT OF CANNED SALMON IN ALASKA, 1914 TO 1920.¹

| Product. | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | Total. |
|------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Coho, or silver: | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> | <i>Cases.</i> |
| 1-pound flat..... | 4,579 | 2,050 | 13,145 | 30,412 | 26,238 | 9,719 | 8,915 | 95,058 |
| 1-pound flat..... | 285 | 2,338 | 8,191 | 362 | 12,786 | 10,438 | 10,746 | 45,146 |
| 1-pound tall..... | 152,199 | 119,880 | 240,573 | 162,457 | 179,934 | 212,713 | 172,424 | 1,240,180 |
| Total..... | 157,063 | 124,268 | 261,909 | 193,231 | 218,958 | 232,870 | 192,085 | 1,380,384 |
| Chum, or keta: | | | | | | | | |
| 1-pound flat..... | 373 | | 1,423 | 26,760 | 3,559 | 3,981 | 53 | 36,149 |
| 1-pound flat..... | 5,568 | 317 | | 2,530 | 2,996 | | 46,167 | 57,578 |
| 1-pound tall..... | 657,918 | 479,629 | 722,692 | 877,457 | 1,358,405 | 1,361,582 | 987,297 | 6,444,980 |
| Total..... | 663,859 | 479,946 | 724,115 | 906,747 | 1,364,960 | 1,365,563 | 1,033,517 | 6,538,707 |
| Humpback, or pink: | | | | | | | | |
| 1-pound flat..... | 2,103 | 4,325 | 41,491 | 91,403 | 63,557 | 28,185 | 18,970 | 250,034 |
| 1-pound flat..... | 9,286 | 3,508 | 14,796 | 6,014 | 20,215 | 7,553 | 76,017 | 137,389 |
| 1-pound tall..... | 974,600 | 1,867,683 | 1,681,506 | 2,193,559 | 2,355,182 | 1,575,870 | 1,498,133 | 12,152,593 |
| Total..... | 986,049 | 1,875,516 | 1,737,793 | 2,296,976 | 2,438,954 | 1,611,608 | 1,593,120 | 12,540,016 |
| King, or spring: | | | | | | | | |
| 1-pound flat..... | 3,143 | 2,401 | 2,617 | 12,973 | 6,000 | 7,584 | 10,196 | 44,917 |
| 1-pound flat..... | 4,804 | 3,755 | 3,804 | 5,133 | 5,267 | 11,532 | 18,319 | 52,614 |
| 1-pound tall..... | 40,092 | 82,092 | 59,452 | 43,845 | 37,959 | 76,870 | 81,488 | 421,798 |
| Total..... | 48,039 | 88,251 | 65,873 | 61,951 | 49,226 | 95,986 | 110,003 | 519,329 |
| Red, or sockeye: | | | | | | | | |
| 1-pound flat..... | 53,825 | 52,033 | 81,565 | 124,309 | 137,008 | 122,236 | 101,716 | 672,692 |
| 1-pound flat..... | 64,671 | 112,847 | 86,395 | 89,612 | 151,864 | 110,491 | 120,147 | 736,027 |
| 1-pound tall..... | 2,083,147 | 1,765,139 | 1,936,971 | 2,274,460 | 2,244,865 | 1,044,934 | 1,278,875 | 12,628,391 |
| 1½-pound nominals..... | | 2,293 | | | | | | 2,293 |
| 2-pound nominals..... | | | 6,006 | | | | | 6,006 |
| Total..... | 2,201,643 | 1,932,312 | 2,110,937 | 2,488,381 | 2,533,737 | 1,277,661 | 1,500,738 | 14,045,400 |
| Grand total..... | 4,056,653 | 4,500,293 | 4,900,627 | 5,947,286 | 6,605,835 | 4,583,688 | 4,429,463 | 35,023,845 |

¹The number of cases shown has been put upon the common basis of 48 1-pound cans per case.

AVERAGE ANNUAL PRICE PER CASE OF FORTY-EIGHT 1-POUND CANS OF SALMON, 1910 TO 1920.

| Product. | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 |
|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|
| Coho, or silver..... | \$4.89 | \$5.67 | \$4.44 | \$3.45 | \$4.39 | \$4.31 | \$5.34 | \$8.76 | \$9.15 | \$11.27 | \$9.13 |
| Chum, or keta..... | 3.04 | 3.72 | 2.37 | 2.21 | 3.37 | 2.59 | 3.34 | 6.14 | 6.27 | 6.82 | 4.19 |
| Humpback, or pink..... | 3.15 | 3.94 | 2.55 | 2.58 | 3.50 | 2.78 | 3.64 | 6.44 | 6.58 | 8.35 | 5.47 |
| King, or spring..... | 5.34 | 6.48 | 5.37 | 4.04 | 5.01 | 4.63 | 5.36 | 10.40 | 9.85 | 13.13 | 10.97 |
| Red, or sockeye..... | 5.30 | 6.33 | 5.45 | 4.54 | 5.58 | 5.82 | 6.04 | 9.48 | 9.44 | 12.98 | 13.05 |

MILD CURING OF SALMON.

The business of mild curing salmon in Alaska fell off materially in 1920, evidence of which is found not only in the smaller pack but also in the withdrawal of six of the largest operators in 1919. Conspicuous among those who withdrew were the Pacific Mild Cure Co., with eight plants, the Columbia & Northern Fishing & Packing Co., Vendsyssel Packing Co., Columbia Salmon Co., and M. B. Dahl & Co. H. R. Thompson, of Ketchikan, was the only important mild curer of last year who continued operations in 1920. The mild curers of 1920 who packed more than 100 tierces each are shown in the following list:

| | |
|---------------------------------------|-----------------|
| Wrangell Cooperative Association..... | Wrangell. |
| Atlantic & Pacific Fisheries Co..... | Port Alexander. |
| Alaska Union Fisheries (Inc.)..... | Port Alexander. |

| | |
|--------------------------|-----------------|
| H. R. Thompson..... | Ketchikan. |
| Karl Hansen..... | Port Alexander. |
| Carlisle Packing Co..... | Yukon River. |

The total investment in the mild-cure salmon industry was \$213,632. Employment was given to 357 persons. The mild-cure products were 2,295 tierces of king salmon, valued at \$364,219, of which 2,120 tierces were prepared in southeastern Alaska, 26 in central, and 149 in the western district.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA SALMON MILD-CURING INDUSTRY IN 1920.

| Items. | Tierces. | Number. | Value. |
|-------------------------------------|----------|----------------|---------|
| INVESTMENT. | | | |
| Plants (all floating)..... | | 4 | \$5,600 |
| Operating capital..... | | | 149,677 |
| Vessels: | | | |
| Power, over 5 tons..... | | 7 | 28,200 |
| Net tonnage..... | | 86 | |
| Launches under 5 tons..... | | 4 | 5,700 |
| Other boats and skiffs..... | | 12 | 5,850 |
| Lighters..... | | 1 | 1,500 |
| Apparatus: | | | |
| Lines..... | | 657 | 1,405 |
| Gill nets..... | | 8 | 3,700 |
| Fathoms..... | | 2,325 | |
| Pound nets..... | | 2 | 12,000 |
| Total..... | | | 213,632 |
| PERSONS ENGAGED.¹ | | | |
| Fishermen: | | | |
| Whites..... | | 306 | |
| Natives..... | | 10 | |
| Total..... | | 316 | |
| Shoresmen: Whites..... | | 28 | |
| Transporters: Whites..... | | 13 | |
| Grand total..... | | 357 | |
| PRODUCTS. | | | |
| | | <i>Pounds.</i> | |
| Southeast Alaska: King salmon..... | 2,120 | 1,717,800 | 341,429 |
| Central Alaska: King salmon..... | 26 | 20,800 | 5,000 |
| Western Alaska: King salmon..... | 149 | 119,200 | 17,790 |
| Total..... | 2,295 | 1,857,800 | 364,219 |

¹ Southeast Alaska only.

SALMON PICKLING.

The pickling of salmon as a branch of the salmon industry is rapidly losing its importance. Since 1918 there has been a shrinkage in investment of \$1,064,836, or 78 per cent. and in production from 56,890 barrels of salmon to 4,822 barrels, or 91.6 per cent. As compared with the situation in 1919, the investment fell off approximately 50 per cent, or from \$590,422 to \$298,681, and production 41 per cent, from 8,110 barrels valued at \$195,447 to 4,822 barrels valued at \$104,873. From an industry employing 815 men in 1918 and 267 in 1919, it has shrunk until only 157 were employed in 1920, all but 2 of whom were credited to western Alaska. The most noticeable changes occurred in central Alaska. In 1919 that district showed approximately 40 per cent of the capital invested in this industry, whereas in 1920 no salteries were operated and no investment reported. Of the two companies listed in that district a year ago, the

Shumagin Packing Co. changed to the canning business, while the Universal By-Products Co. did not operate. Western Alaska produced 85 per cent of the pack of pickled salmon in 1920, the most conspicuous operators being Libby, McNeill & Libby, Bering Sea Salmon Packing Co., Golden Gate Salmon Co., Peter M. Nelson, and Alaska Salmon Co.

Statistics regarding the salmon-pickling industry in 1920 appear in the following table:

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA SALMON-PICKLING INDUSTRY IN 1920.

| Items. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|------------------------------|-------------------|---------|-----------------|--------|-----------------|----------|-----------|----------|
| | Quantity. | Value. | Quantity. | Value. | Quantity. | Value. | Quantity. | Value. |
| INVESTMENT. | | | | | | | | |
| Salteries..... | No. 1 | \$8,000 | No. | | No. 6 | \$70,547 | No. 7 | \$78,547 |
| Operating capital..... | | | | | | 106,336 | | 106,336 |
| Vessels: | | | | | | | | |
| Sailing..... | | | | | 2 | 50,000 | 2 | 50,000 |
| Net tonnage..... | | | | | 719 | | 719 | |
| Launches..... | 1 | 1,500 | 1 | \$500 | 11 | 34,056 | 13 | 36,056 |
| Gill net boats..... | | | | | 33 | 10,175 | 33 | 10,175 |
| Rowboats and skiffs..... | | | | | 8 | 615 | 8 | 615 |
| Lighters and scows..... | | | | | 5 | 3,900 | 5 | 3,900 |
| Pile drivers..... | | | | | 1 | 250 | 1 | 250 |
| Apparatus: | | | | | | | | |
| Haul seines..... | 1 | 300 | 1 | 60 | | | 2 | 360 |
| Fathoms..... | 75 | | 50 | | | | 125 | |
| Gill nets..... | | | | | 161 | 11,942 | 161 | 11,942 |
| Fathoms..... | | | | | 9,620 | | 9,620 | |
| Wheels..... | | | | | 2 | 500 | 2 | 500 |
| Total..... | | 9,800 | | 560 | | 288,321 | | 298,681 |
| PERSONS ENGAGED. | | | | | | | | |
| Fishermen: | | | | | | | | |
| Whites..... | | | 2 | | 60 | | 62 | |
| Natives..... | | | | | 3 | | 3 | |
| Total..... | | | 2 | | 63 | | 65 | |
| Shoresmen: | | | | | | | | |
| Whites..... | | | | | 43 | | 43 | |
| Natives..... | | | | | 26 | | 26 | |
| Mexicans..... | | | | | 13 | | 13 | |
| Total..... | | | | | 82 | | 82 | |
| Transporters: Whites..... | | | | | 10 | | 10 | |
| Grand total..... | | | 2 | | 155 | | 157 | |
| PRODUCTS.¹ | | | | | | | | |
| | Barrels. | | Barrels. | | Barrels. | | Barrels. | |
| Coho, or silver..... | 110 | 2,160 | 183 | 3,880 | 109 | 2,090 | 402 | 8,130 |
| Chum, or keta..... | 105 | 1,400 | | | 119 | 2,360 | 224 | 3,760 |
| Humpback, or pink..... | 61 | 882 | | | 135 | 1,400 | 196 | 2,282 |
| King, or spring..... | 100 | 2,000 | 8 | 160 | 144 | 3,201 | 252 | 5,361 |
| Red, or sockeye..... | 164 | 3,280 | 6 | 150 | 3,578 | 81,910 | 3,748 | 85,340 |
| Total..... | 540 | 9,722 | 197 | 4,190 | 4,085 | 90,961 | 4,822 | 104,873 |

¹ Each barrel holds 200 pounds of fish.

SALMON FREEZING.

The freezing of salmon in 1920 was carried on as a business of secondary importance by six companies primarily engaged in other branches of the fishery industry of Alaska. These companies, operating seven plants, reported an output of frozen salmon of 1,916,595

pounds, valued at \$161,143, an increase of 364,115 pounds in production and \$30,788 in value over corresponding quantities and values for 1919. This business represents no investment as distinguishable from that of the major activities of the companies concerned.

The output of frozen salmon was prepared by the following companies: Libby, McNeill & Libby, Sunny Point Packing Co., National Independent Fisheries Co., New England Fish Co., San Juan Fishing & Packing Co., and Booth Fisheries Co.

QUANTITY AND VALUE OF SALMON FROZEN IN ALASKA IN 1920, BY SPECIES.

| Species. | Pounds. | Value. |
|------------------------|-------------|-----------|
| Coho, or silver..... | 134, 134 | \$10, 624 |
| Chum, or keta..... | 448, 634 | 19, 049 |
| Humpback, or pink..... | 105, 816 | 7, 276 |
| King, or spring..... | 1, 143, 765 | 115, 770 |
| Red, or sockeye..... | 84, 246 | 8, 424 |
| Total..... | 1, 916, 595 | 161, 143 |

FRESH SALMON.

The trade in fresh salmon in Alaska declined markedly in 1920 as compared with 1919, a condition doubtless due to the shortened supply and the greater demand for salmon by the canneries. As heretofore, this business was carried on almost wholly in south-eastern Alaska and by operators more particularly engaged in other branches of the fishery industry. The bulk of the trade was represented by the business of the firms listed below:

| | |
|---|-------------------|
| Hoonah Packing Co..... | Hoonah. |
| Wrangell Cooperative Association..... | Wrangell. |
| Annette Island Packing Co..... | Metlakatla. |
| National Independent Fisheries Co..... | { Juneau. |
| H. Bergman..... | { Ketchikan. |
| Atlantic & Pacific Fisheries Co..... | { Port Alexander. |
| Petersburg Cooperative Association..... | { Douglas. |
| Ripley Fish Co..... | { Petersburg. |
| H. R. Thompson..... | { Ketchikan. |
| Juneau Cold Storage Co..... | Juneau. |
| San Juan Fishing & Packing Co..... | Ketchikan. |
| Karl Hansen..... | Port Alexander. |

The total quantity of salmon sold fresh was 3,248,081 pounds, valued at \$263,264. This is 38 per cent less than the production in 1919.

PRODUCTS OF ALASKA FRESH-SALMON TRADE IN 1920.

| Species. | Pounds. | Value. |
|------------------------|-------------|-----------|
| Coho, or silver..... | 273, 020 | \$11, 784 |
| Chum, or keta..... | 212, 444 | 9, 052 |
| Humpback, or pink..... | 203, 444 | 3, 122 |
| King, or spring..... | 2, 474, 733 | 234, 474 |
| Red, or sockeye..... | 54, 440 | 4, 832 |
| Total..... | 3, 248, 081 | 263, 264 |

DRY SALTING OF SALMON.

The Kuskokwim Salmon Co., which was formed as a consolidation of the interests of the Kuskokwim Fishing & Transportation Co. and the Northern Fisheries (Inc.), on the Kuskokwim River, was engaged in the packing of dry-salted salmon in Alaska in 1920. The investment in miscellaneous supplies, small boats, fishing apparatus, and wages amounted to \$45,232. Employment was given to 28 whites and 15 natives. The products were as follows:

PRODUCTS OF THE DRY-SALTING SALMON BUSINESS IN ALASKA IN 1920.

| Species. | Pounds. | Value. |
|----------------------|---------|---------|
| Coho, or silver..... | 42,200 | \$4,642 |
| Chum, or keta..... | 7,800 | 881 |
| King, or spring..... | 152,640 | 28,440 |
| Red, or sockeye..... | 22,200 | 3,572 |
| Total..... | 224,840 | 37,535 |

There was an increase in production over 1919 of 12,596 pounds of dry-salted salmon, and in value of \$19,934.

DRYING AND SMOKING OF SALMON.

As a commercial undertaking the drying and smoking of salmon in 1920 was unimportant; the only reported products of that kind were 15,000 pounds of kippered salmon, valued at \$3,000, prepared by the Juneau Cold Storage Co., at Juneau, and 5,000 pounds of humpback salmon, valued at \$250, dried at Uyak by Peter Petrovsky.

Whites and natives living along the larger rivers of Alaska dry or smoke considerable quantities of salmon annually for local uses, but reliable figures of the number so used were not obtainable. These methods of preparing salmon were practiced chiefly in the Yukon Valley, where the inhabitants depend largely on such products for human needs and for dog food. In the coastal regions of Alaska, particularly those localities where winter temperatures are comparatively moderate, very limited quantities of salmon are dried or smoked. The possibility of taking cod and other sea foods at practically any time of the year obviates the necessity of preparing other fishery products for winter use.

SALMON BY-PRODUCTS.

The utilization of offal and waste material at the salmon canneries in Alaska in the manufacture of oil and fertilizer as a branch of the salmon industry revived somewhat in 1920, and was centered wholly in the southeastern district. Three companies were engaged exclusively in this business, while four were primarily concerned in the canning of salmon. In the first category are the Fish Canners' By-Products Co., which resumed operations at Ward Cove; the Alaska Reduction Co., which established a plant at Hawk Inlet; and the Petersburg By-Products Co., which operated at Scow Bay; in the other class were the Alaska Herring & Sardine Co., at Port

Walter; John L. Carlson & Co., at Auk Bay; Hoonah Packing Co., at Hoonah; and the Pacific American Fisheries, at Excursion Inlet and Ikatan.

The investment in this industry amounted to \$375,127. Employment was given to 90 whites, 23 natives, 13 Mexicans, and 13 others, or a total of 139 men.

In 1920 there were produced as salmon by-products 889 tons of fertilizer, valued at \$88,382, and 39,052 gallons of oil, valued at \$16,370. The total value of these products was \$104,752, an increase of \$85,106 over the value of similar products in 1919.

HALIBUT FISHERY.

Halibut are taken on banks of the North Pacific Ocean by vessels from ports of Washington, British Columbia, and Alaska. American vessels deliver their fares indiscriminately in those regions, controlling factors in the selection of a port of delivery being the market price of halibut and the cost of supplies. As the bulk of the catch of halibut in 1920 from Pacific waters was made on the high seas, beyond the jurisdiction of any country, Alaska is credited only with so much of the catch as was landed at her ports. Ordinarily this apportionment of the catch would tend to reduce the amount shown as the product of Alaska, for in recent years there was a marked diversion of fares to the more southerly ports, but in 1920 this condition was not so evident, there being a notable increase in the quantity of halibut handled through Alaskan ports. Deliveries in 1920 exceeded those of 1919 by 1,016,709 pounds.

STATISTICAL SUMMARY.

In arriving at the investment in the halibut industry as credited to Alaska an estimate was made of the value of all vessels, including apparatus, which made one or more landings of fares at ports in Alaska. In the same manner an estimate was made of the number of persons employed in this industry. On this basis the investment is given as \$2,270,722, an increase of \$291,265. The number of persons employed in the halibut fishery was 768, as against 867 in 1919. The production in 1920 was 15,295,500 pounds, valued at \$1,726,798, as compared with 14,278,791 pounds, valued at \$1,550,605, in 1919.

The companies which handled the bulk of the halibut exported from Alaska were the National Independent Fisheries Co., at Juneau and Ketchikan; Jack Bailey, Pacific Sea Products Association (Inc.), New England Fish Co., and the Ripley Fish Co., at Ketchikan; San Juan Fishing & Packing Co., at Seward and Ketchikan; and the Booth Fisheries Co., at Sitka.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA HALIBUT FISHERY
IN 1920.

| Item. | Quantity. | Value. | Item. | Quantity. | Value. |
|------------------------|----------------|---------------|------------------------------|----------------|---------------|
| INVESTMENT. | | | PERSONS ENGAGED. | | |
| Fishing vessels: | <i>Number.</i> | | Whites..... | <i>Number.</i> | |
| Steam and gas..... | 102 | \$1, 281, 246 | Natives..... | 744 | |
| Net tonnage..... | 1, 954 | | | 24 | |
| Launches..... | 35 | 53, 400 | Total..... | 768 | |
| Dories and scows..... | 155 | 11, 700 | PRODUCTS. | | |
| Fishing apparatus..... | | 86, 124 | | <i>Pounds.</i> | |
| Shore property..... | | 357, 833 | Fresh (including local)..... | 7, 506, 763 | \$1, 034, 380 |
| Cash capital..... | | 480, 419 | Frozen..... | 7, 788, 017 | 692, 343 |
| | | | Canned (15 cases)..... | 720 | 75 |
| Total..... | | 2, 270, 722 | Total..... | 15, 205, 500 | 1, 726, 798 |

HERRING FISHERY.

In the aggregate, the production of herring in Alaska in 1920 was greater than ever before, but there was a wide variation in the quantity of certain products as compared with the previous year. In 1919 approximately 52 per cent of the catch of herring was used in the preparation of pickled and canned herring and other food products. In 1920 almost 80 per cent of the catch of herring was used as bait or in the manufacture of fertilizer and oil. Of 15 companies handling herring in southeast Alaska, 7 were primarily operators of reduction plants, 6 were handling herring exclusively for bait, and 2, the smallest operators of all, were engaged wholly in the preparation of food products. In central Alaska the situation was decidedly different. There were 13 operators, all of whom were chiefly engaged in the preparation of food products, while 2 operated reduction works in connection with or supplemental to the packing of pickled herring. All herring taken in western Alaska were pickled: the limited output resulted from the operations of three packers at Golovin Bay.

STATISTICAL SUMMARY.

The herring industry shows an investment in Alaska of \$1,396,612, an increase of 55 per cent over the investment in 1919. Employment was given to 376 persons, as compared with 427 in 1919. Products were valued at \$1,303,614, as against \$1,676,170 in 1919, a decrease of \$372,556. Out of a total of 8,751,405 pounds of food products, approximately 94 per cent was prepared as Scotch-cured herring. This was an increase from 7,718,985 pounds in 1919 to 8,223,490 pounds in 1920, or 6½ per cent.

In the same period the Norwegian-cured product decreased from 2,216,120 pounds to 344,619 pounds, or approximately 84½ per cent.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA HERRING FISHERY IN 1920.

| Item. | Southeast Alaska. | | Central Alaska. | | Western Alaska. | | Total. | |
|-----------------------------------|-------------------|-----------|-----------------|-----------|-----------------|---------|------------|-----------|
| | Num-ber. | Value. | Num-ber. | Value. | Num-ber. | Value. | Number. | Value. |
| INVESTMENT. | | | | | | | | |
| Plants operated..... | 5 | \$139,670 | 7 | \$284,828 | 2 | | 14 | \$424,498 |
| Operating capital..... | | 243,694 | | 549,443 | | \$3,050 | | 796,187 |
| Vessels: | | | | | | | | |
| Power vessels over 5 tons. | 8 | 35,433 | 11 | 63,500 | | | 19 | 98,933 |
| Net tonnage..... | 195 | | 233 | | | | 428 | |
| Launches under 5 tons. | 1 | 2,000 | 6 | 8,300 | | | 7 | 10,300 |
| Boats, row and seine. | 15 | 1,400 | 36 | 2,835 | 1 | 80 | 52 | 4,315 |
| Lighters and scows..... | 3 | 4,900 | 8 | 9,100 | | | 11 | 14,000 |
| Pile drivers..... | 1 | 1,500 | 1 | 3,000 | | | 2 | 4,500 |
| Apparatus: | | | | | | | | |
| Beach seines..... | 4 | 2,300 | 9 | 7,050 | | | 13 | 9,350 |
| Fathoms..... | 215 | | 1,135 | | | | 1,350 | |
| Purse seines..... | 8 | 12,449 | 9 | 18,300 | 1 | 350 | 18 | 31,299 |
| Fathoms..... | 1,510 | | 1,770 | | 100 | | 3,380 | |
| Gill nets..... | | | 17 | 2,450 | 24 | 780 | 41 | 3,230 |
| Fathoms..... | | | 850 | | 400 | | 1,250 | |
| Total..... | | 443,346 | | 949,006 | | 4,260 | | 1,396,612 |
| PERSONS ENGAGED. | | | | | | | | |
| Fishermen: | | | | | | | | |
| Whites..... | 52 | | 67 | | | | 119 | |
| Natives..... | 2 | | | | 1 | | 3 | |
| Others..... | 4 | | | | | | 4 | |
| Total..... | 58 | | 67 | | 1 | | 126 | |
| Shoresmen: | | | | | | | | |
| Whites..... | 42 | | 166 | | | | 208 | |
| Natives..... | 27 | | 1 | | 2 | | 30 | |
| Others..... | 8 | | | | | | 8 | |
| Total..... | 77 | | 167 | | 2 | | 246 | |
| Transporters: Whites..... | | | 4 | | | | 4 | |
| Grand total..... | 135 | | 238 | | 3 | | 376 | |
| PRODUCTS. | | | | | | | | |
| Canned (1-pound cans)..... | | | | | | | 13,602 | 28,980 |
| Fresh for food..... | | | | | | | 2,400 | 105 |
| Fresh for bait..... | | | | | | | 21,559,100 | 21,167 |
| Frozen for bait..... | | | | | | | 2,525,700 | 20,027 |
| Pickled for food, Scotch cure. | | | | | | | 8,223,490 | 490,485 |
| Pickled for food, spiced. | | | | | | | 8,000 | 400 |
| Pickled for food, Norwegian cure. | | | | | | | 2,344,619 | 22,199 |
| Fertilizer..... | | | | | | | 26,078,000 | 316,161 |
| Oil..... | | | | | | | 2681,067 | 404,090 |
| Total..... | | | | | | | | 1,303,614 |

¹ Cases.² Pounds.³ Gallons.

COD FISHERY.

The changes of note in the cod industry of Alaska in 1920 were increases in production of 17 per cent, 14 per cent in number of persons employed, and 60 per cent in investment. These expansions are recorded notwithstanding the withdrawal of J. A. Matheson, of Anacortes, Wash., who for many years was listed as an important operator in the vessel fishery of western Alaska. The Bering Sea Fisheries Co. appears as a new concern in this industry, but in reality it is understood to be only an organization of the interests previously

shown under the name of Lars Mikkelsen. Operations by the Pacific American Fisheries in the vicinity of Unimak Island and W. J. Erskine Co. in the Kodiak region account largely for the increased production of cod in 1920 over that of 1919. It is noteworthy that approximately 28 per cent of the cod taken in Alaskan waters was reported as of shore-station catch. Generally the smaller producers of cod are the operators of shore stations only.

The Alaska cod industry is facing a decline of serious proportions in view of the active competition which has developed rather recently through deliveries of cod by Japanese vessels. Under present conditions this competition bids fair to increase to the great disadvantage of the Alaska cod industry.

VESSEL FISHERY.

Owing to the withdrawal of J. A. Matheson, the schooner *Fanny Dutard* does not appear in the list of vessels forming the cod fleet of 1920. The *Chas. R. Wilson*, a schooner heretofore listed as one of the vessels of the Pacific Coast Codfish Co., was also withdrawn from the Alaska field. Offsetting these withdrawals are two notable additions to the list of vessels in the fleet of 1920. One was that of the schooner *S. N. Castle*, belonging to the Alaska Codfish Co., and the other that of the schooner *Carolyn Frances*, owned by the Union Fish Co., which company further increased its fleet by adding the schooners *Eunice*, *Mary E.*, *Chas. E. Brown*, and the power schooner *Progress*. The W. J. Erskine Co. reported nine small vessels engaged in cod fishing at Kodiak, two of which were listed in 1919. The Alaska Codfish Co. added the *Alasco IV* to its fleet of small power vessels in Alaska.

The fleet in 1920 was composed of 36 vessels, 16 of which were schooners of more than 100 tons register. This is an increase of 11 over the number listed in 1919. The total tonnage of the fleet in 1920 was 5,171 net tons, as compared with 4,234 net tons in 1919.

SHORE STATIONS.

The important shore stations of Alaska were operated and located as follows: O. Kraft & Son at Kodiak; the Union Fish Co. and the Alaska Codfish Co. at several stations in the Shumagin and Sanak Islands; the Bering Sea Fisheries Co. at Unga; and four stations in the Aleutian Islands Reservation.

ALASKA COD FLEET IN 1920.

| Name. | Rig. | Net tonnage. | Operators. |
|----------------------|---------------------|--------------|---|
| City of Papeete..... | Schooner..... | 370 | Alaska Codfish Co., San Francisco, Calif. |
| Glendale..... | do..... | 281 | Do. |
| Maweema..... | do..... | 392 | Do. |
| S. N. Castle..... | do..... | 464 | Do. |
| Alasco..... | Power schooner..... | 23 | Do. |
| Alasco II..... | do..... | 5 | Do. |
| Alasco III..... | do..... | 8 | Do. |
| Alasco IV..... | do..... | 14 | Do. |
| Trio..... | do..... | 9 | Alaska Ocean Food Co., Seattle, Wash. |
| Dora..... | Steamer..... | 217 | Bering Sea Fisheries Co., Seattle, Wash. |
| Lister..... | Power schooner..... | 15 | W. J. Erskine Co., Kodiak, Alaska. |
| Pilgrim..... | do..... | 8 | Do. |
| Northern King..... | do..... | 8 | Do. |
| Patmos..... | do..... | 17 | Do. |

ALASKA COD FLEET IN 1920—Continued.

| Name. | Rig. | Net tonnage. | Operators. |
|----------------------|---------------------|-----------------|---|
| Edith..... | Power schooner..... | 7 | W. J. Erskine Co., Kodiak, Alaska. |
| Buffalo..... | do..... | 15 | Do. |
| Flossie..... | do..... | 6 | Do. |
| Nimrod..... | do..... | 8 | Do. |
| North Star..... | do..... | 15 | Do. |
| John A..... | Schooner..... | 235 | Pacific Coast Codfish Co., Seattle, Wash. |
| Maid of Orleans..... | do..... | 171 | Do. |
| Alice..... | do..... | 220 | Robinson Fisheries Co., Anacortes, Wash. |
| Wawona..... | do..... | 413 | Do. |
| Golden State..... | Power schooner..... | 223 | Union Fish Co., San Francisco, Calif. |
| Eunice..... | Schooner..... | 35 | Do. |
| Progress..... | Power schooner..... | 115 | Do. |
| Mary E..... | do..... | 21 | Do. |
| Chas. E. Brown..... | Schooner..... | 64 | Do. |
| Carolyn Frances..... | do..... | 422 | Do. |
| Sequoia..... | do..... | 324 | Do. |
| Galilee..... | do..... | 328 | Do. |
| Benlah..... | do..... | 339 | Do. |
| Louise..... | do..... | 328 | Do. |
| Martha..... | do..... | 14 | Do. |
| Pirate..... | Power schooner..... | 30 | Do. |
| Union Flag..... | do..... | 7 | Do. |

STATISTICAL SUMMARY.

The total investment in the cod industry of Alaska in 1920 was \$2,057,728, as compared with \$1,286,075 in 1919, an increase of \$771,653. Employment was given to 803 men, as against 702 in 1919. The production of cod in 1920 was 12,763,899 pounds, valued at \$1,117,464, being an increase over the output of 1919 by 1,870,587 pounds and \$291,474 in value.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA COD FISHERY IN 1920.

| Item. | Quantity. | Value. | Item. | Quantity. | Value. |
|--------------------------------|-----------|-------------|---------------------------|--------------|-------------|
| INVESTMENT. | | | PERSONS ENGAGED—contd. | | |
| Value of shore stations..... | Number. | \$405, 583 | Transporters: Whites..... | 41 | ..... |
| Cost of operations..... | | 490, 229 | Grand total..... | 803 | ..... |
| Wages paid..... | | 440, 384 | PRODUCTS. | | |
| Vessels: | | | Vessel catch: | Pounds. | |
| Power vessels over 5 tons..... | 20 | 232, 912 | Dry-salted cod..... | 8, 887, 339 | \$712, 918 |
| Net tonnage..... | 767 | | Pickled cod..... | 168, 730 | 10, 123 |
| Sailing..... | 16 | 380, 074 | Fresh cod..... | 565 | 23 |
| Net tonnage..... | 4, 400 | | Tongues..... | 16, 600 | 1, 244 |
| Launches..... | 115 | 67, 373 | Total..... | 9, 073, 234 | 724, 338 |
| Dories..... | 371 | 17, 761 | Shore-station catch: | | |
| Pile drivers..... | 3 | 3, 603 | Dry-salted cod..... | 1, 949, 082 | 219, 162 |
| Apparatus: | | | Pickled cod..... | 1, 726, 908 | 171, 524 |
| Seines (75 fathoms)..... | 1 | 250 | Stockfish..... | 12, 775 | 2, 300 |
| Gill nets (75 fathoms)... | 1 | 195 | Tongues..... | 1, 000 | 140 |
| Lines..... | 472 | 19, 364 | Total..... | 3, 690, 665 | 393, 126 |
| Total..... | | 2, 057, 728 | Total: | | |
| PERSONS ENGAGED. | | | Dry-salted cod..... | 10, 837, 321 | 932, 110 |
| Fishermen: | | | Pickled cod..... | 1, 895, 638 | 181, 647 |
| Whites..... | 695 | ..... | Fresh cod..... | 565 | 23 |
| Natives..... | 38 | ..... | Stockfish..... | 12, 775 | 2, 300 |
| Total..... | 733 | ..... | Tongues..... | 17, 600 | 1, 384 |
| Shoresmen: | | | Grand total..... | 12, 763, 899 | 1, 117, 464 |
| Whites..... | 27 | ..... |  |  |  |
| Natives..... | 2 | ..... |  |  |  |
| Total..... | 29 | ..... |  |  |  |

The known losses in the cod industry were comparatively small. Three fishermen were drowned and one shoresman was accidentally killed. The loss of small boats and fishing tackle, valued at \$10,461, and the loss of the steamer *Dora*, owned by the Bering Sea Fisheries Co., and valued at \$50,000, were reported. The *Dora* was wrecked on December 20, 1920, at Hardy Bay, on the northeast coast of Vancouver Island, B. C., and thus, after 40 years of almost continuous service, at times under very trying conditions, there was lost the most historic vessel plying Alaskan waters.

WHALE FISHERY.

SHORE STATIONS.

Whaling operations in Alaska in 1920 were carried on by four companies, namely, United States Whaling Co., at Port Armstrong; North Pacific Sea Products Co., at Akutan; J. A. Magill & Co., at Beluga River, on Cook Inlet; and the Arctic Whaling & Fishing Co., at Golovin Bay.

The North Pacific Sea Products Co. operated four steam whaling vessels, the *Kodiak* and *Unimak* (each 99 tons net), *Tanginak* (71 tons net), and the *Paterson* (77 tons net). It also used the barge *Fresno* (1,149 tons net) and the steamer *Elihu Thomson* (449 tons net) as transporting vessels. Its operations were carried on in the waters of the Pacific Ocean and Bering Sea contiguous to the Aleutian Islands. Four species of whales were taken—the finback, humpback, sulphur-bottom, and sperm—almost half of the catch being finbacks. A total of 290 whales was taken by this company.

The United States Whaling Co. operated in the coastal waters of southeastern Alaska from Dixon Entrance to Cross Sound, the important hunting ground paralleling the coast at an approximate distance of 25 miles. Three steam whaling vessels were engaged in the hunting of whales. They were *Star I* (133 tons net) and *Star II* and *Star III* (each 97 tons net). A total of 139 whales was taken. Five species were represented, the sei whale being secured in addition to the four species taken in western Alaska.

J. A. Magill & Co. operated the plant on Beluga River, formerly controlled by the Beluga Whaling Co. This company captured 100 belugas or white whales, this being by far the most successful season experienced at that station.

The Arctic Whaling & Fishing Co. operated in the vicinity of Nome and succeeded in capturing 136 belugas.

STATISTICAL SUMMARY.

The whaling industry of Alaska shows an investment of \$1,700,910 in 1920, a decrease of \$89,957 from 1919. It gave employment to 318 men, or 7 more than in 1919. Whale products were valued at \$562,302, as compared with \$1,027,200 in 1919. The total number of whales taken was 665, or 85 more than in the preceeding season.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA SHORE WHALING OPERATIONS IN 1919.

| Items. | Number. | Value. | Items. | Number. | Value. |
|----------------------------|---------|-----------|-----------------------|----------------------|-----------|
| INVESTMENT. | | | PRODUCTS. | | |
| Vessels: | | | Whales: | | |
| Steam and gas..... | 9 | \$471,000 | Finback..... | 179 | ..... |
| Net tonnage..... | 1,121 | ..... | Humpback..... | 75 | ..... |
| Barge..... | 1 | 30,000 | Sulphur-bottom..... | 81 | ..... |
| Net tonnage..... | 1,149 | ..... | Sperm..... | 90 | ..... |
| Launches under 5 tons..... | 5 | 6,400 | Sei..... | 4 | ..... |
| Row boats..... | 19 | 1,360 | Beluga..... | 236 | ..... |
| Scows..... | 5 | 2,800 | Total..... | 665 | ..... |
| Pile driver..... | 1 | 150 | Whale oil..... | ¹ 765,309 | \$304,256 |
| Value of plants..... | | 366,246 | Sperm oil..... | ¹ 343,611 | 131,783 |
| Cash capital..... | | 546,946 | Fertilizer, meat..... | ² 1,218 | 101,105 |
| Wages paid..... | | 276,008 | Fertilizer, bone..... | ² 377 | 18,815 |
| Total..... | | 1,700,910 | Whalebone..... | ³ 17,484 | 6,118 |
| PERSONS ENGAGED. | | | Ivory, sperm..... | ³ 750 | 225 |
| Whites..... | 239 | ..... | Total..... | | 562,302 |
| Natives..... | 46 | ..... |  |  |  |
| Japanese..... | 33 | ..... |  |  |  |
| Total..... | 318 | ..... |  |  |  |

¹ Gallons.² Tons.³ Pounds.

CLAM CANNING.

A few years ago the canning of clams in Alaska gave promise of becoming an industry of some consequence, as it was then generally held that the areas occupied by clams were reasonably extensive, fairly accessible, and that they might support an independent industry for some time to come; but to date almost no attempt has been made to develop clam fisheries at any other locality than the Cordova district. Production in that field began to decline in 1919. The results of operations in 1920, with only one company packing clams at Cordova as against three in 1918, show that this decline is still in progress. In addition to the exhaustion of the clam beds it was also apparent that the increasing cost of the raw product to the packers was a vital factor in the life of the industry. Owing to the diminution in the supply of clams the diggers encountered greater difficulty in making wages, which necessitated a demand from them for a higher rate per pound for clams.

Clam canning was carried on by the Pioneer Packing Co., at Cordova; Surf Packing Co., at Chisik Island, Cook Inlet; and the Douglas Island Packing Co., at Douglas. These companies were also engaged in canning salmon, for which reason the plant investment is credited to that industry. There were employed 57 diggers, to whom wages amounting to \$9,387 were paid. A total of 6,833 cases of clams and clam juice was prepared, the value of which was \$46,812.

PRODUCTS OF ALASKA CLAM-CANNING INDUSTRY IN 1920.

| Items. | Cases. | Value. |
|--|--------|---------|
| Minced clams: | | |
| 1-pound cans (48 per case)..... | 424 | \$3,384 |
| No. 1 eastern oyster cans (48 per case)..... | 5,876 | 41,132 |
| 1-pound cans (48 per case)..... | 17 | 136 |
| 2-pound cans..... | 380 | 1,748 |
| Clam juice, 8-pound cans..... | 136 | 412 |
| Total..... | 6,833 | 46,812 |

MINOR FISHERIES.

TROUT.

The output of trout in Alaska in 1920 was practically equal in quantity and value to that of 1919, when it was valued at \$13,155 as against \$13,662 in the past year. Southeastern Alaska led in production, as approximately but 20 per cent of the catch came from central and western Alaska, as compared with 27 per cent from those districts in 1919 and 79 per cent in 1918. The chief factor contributing to this result was the continued closure of the cannery of the Midnight Sun Packing Co., at Kotzebue Sound, where a few thousand cases of Dolly Vardens were canned annually prior to 1919.

The bulk of the catch of both steelhead and Dolly Varden trout was handled as fresh or frozen fish by the Ripley Fish Co., and Libby, McNeill & Libby, in southeastern Alaska. All canned trout came from central and western Alaska. No investment is credited to this business, as all operations were incidental to halibut and salmon industries.

PRODUCTS OF ALASKA TROUT FISHERY IN 1920.

| Section and species. | Fresh. | | Frozen. | | Pickled. | | Canned. | |
|-----------------------------------|---------|---------|---------|---------|----------|--------|---------|---------|
| | Pounds. | Value. | Pounds. | Value. | Barrels. | Value. | Cases. | Value. |
| Southeast Alaska: | | | | | | | | |
| Steelhead..... | 26,751 | \$1,414 | 17,344 | \$2,601 | | | | |
| Dolly Varden..... | 26,326 | 6,726 | 250 | 25 | 5 | \$75 | | |
| Total..... | 53,077 | 8,140 | 17,594 | 2,626 | 5 | 75 | | |
| Central: | | | | | | | | |
| Steelhead..... | | | | | | | 427 | \$2,126 |
| Dolly Varden..... | 3,420 | 342 | 379 | 20 | 5 | 75 | | |
| Total..... | 3,420 | 342 | 379 | 20 | 5 | 75 | 427 | 2,126 |
| Western Alaska: Dolly Varden..... | | | | | | | 43 | 258 |
| Grand total..... | 56,497 | 8,482 | 17,973 | 2,646 | 10 | 150 | 470 | 2,384 |

SABLEFISH.

As may be generally known, the catch of sablefish each year is made almost wholly by halibut fishermen operating in the offshore waters of Alaska, and the quantity reported annually fluctuates with market demands and the willingness of the fishermen to utilize space in their boats for sablefish which might be filled more profitably with

halibut. In 1920 the production of sablefish reached a total of 584,251 pounds, valued at \$28,544. There was an increase of 74,882 pounds in products but a decline of \$6,941 in value from the corresponding figures reported in 1919. Statistics show that 565,926 pounds, valued at \$27,770, were frozen; 3,000 pounds, valued at \$140, were pickled; and 15,325 pounds, valued at \$634, were shipped fresh to the States.

CRABS.

Some change was noted in 1920 with respect to the utilization of crabs in Alaska. The Arctic Packing Co. and Eda O. Kitzman canned experimentally a few cases of crabs at Seldovia, in central Alaska. John Murphy, at Tenakee, was the only operator engaged in crab fishing in southeastern Alaska. The investment in the crab fishery was \$750. The products were 70 cases of canned crabs, valued at \$1,050, and 6,350 pounds of crabs sold fresh for \$690. The total value of all crab products was \$1,740.

SHRIMPS.

Encouraging interest in the shrimp fishery of southeastern Alaska was manifested in 1920 by the Alaskan Glacier Sea Food Co., at Petersburg. The investment in the shrimp industry was reported as \$76,100, of which amount \$24,500 was paid in wages to 14 whites, 5 natives, 20 Japanese, and 1 Mexican. Four boats and six trawls, valued at \$29,600, were operated in this fishery. The total production of shrimp was 112,045 pounds, valued at \$49,123. The products of this fishery were more than double those of 1919, and it would therefore seem that the competition of the southern shrimp fisheries had not seriously affected operations in Alaska.

MISCELLANEOUS FISHERY PRODUCTS.

This classification of products includes red rockfish, flatfish, and smelts. Products aggregated 11,073 pounds, valued at \$229, practically all of which were frozen.

FUR-SEAL INDUSTRY.

PRIBILOF ISLANDS.

GENERAL ADMINISTRATIVE WORK.

In 1920 the work of the Bureau at the Pribilof Islands was carried on in the usual manner. Sealing operations were upon practically the same scale as in the previous year, but a more extensive study of experimental methods in taking and curing skins was made, the results of which will be applied upon a commercial scale in succeeding seasons. The take of pelts from the blue fox herds was the largest for many years. Progress was made in construction work, additional housing facilities being provided for natives on St. Paul Island and increased salt house and workshop space on both islands to handle larger takes of fur-seal and fox skins. The census of the fur-seal herd was taken as usual. The annual supplies for the islands were transported chiefly by the Navy Department, but considerable assistance was given by Coast Guard vessels, and the Bureau's vessel *Eider* rendered valuable service between Unalaska and the Pribilofs.

PERSONNEL.

Effective July 1, Agent and Caretaker A. H. Proctor, of St. Paul Island, was appointed to the new position of superintendent, Pribilof Islands, to have general direction of the work on the two islands. Storekeeper H. D. Aller, who had been detailed to the Washington office during the previous winter, was appointed agent and caretaker of St. Paul Island, arriving there October 26 on the U. S. S. *Saturn*. When Agent and Caretaker Charles E. Crompton left for the States September 9 on the *Saturn*, St. George Island was placed in charge of Storekeeper E. C. Johnston. After taking leave of absence, Mr. Crompton proceeded east via St. Louis, arriving at the Washington office January 5, 1921, for duty through the winter. School-teacher E. C. Johnston, of St. George Island, was appointed storekeeper, effective April 27; he was succeeded by Carl E. Fletcher, who reached the island on the *Saturn* June 16, and, having tendered his resignation, left on the same vessel in October. John M. Orchard was then appointed school-teacher of St. George Island and arrived there on the *Saturn* October 29. Herschel Silverstone, assistant to the agent on St. Paul Island, tendered his resignation and left by the Coast Guard cutter *Bear* in October. Mr. Silverstone was succeeded by Henry Mygatt, who arrived on the *Saturn* October 26. Assistant Agent H. C. Scudder was appointed storekeeper on St. Paul Island, arriving there October 26. George Haley resigned as school-teacher

on St. Paul Island and left the islands on the *Saturn* in June. Mr. Haley was succeeded by Richard Culbertson, who arrived at St. Paul Island on the *Saturn* June 17. Dr. Washington C. Huyler was appointed physician for St. Paul Island, but resigned soon after his arrival and returned on the *Saturn* in November. Dr. J. J. Richstein, resigned, left St. Paul Island at the same time. Dr. G. B. Bowlby was appointed to succeed Dr. Huyler and was en route to the island via Kodiak at the close of the year. Warden Joseph N. Braun arrived at St. George Island on the *Algonquin* September 19, having been detailed for general duty there during the winter.

In the list of temporary employees was Dr. G. Dallas Hanna, curator of invertebrate paleontology at the California Academy of Sciences and formerly in the Alaska service of the Bureau, who arrived at the islands on the *Saturn* June 16 and left on the same vessel September 9; in the interim he was engaged in taking the annual census of fur seals, making several trips between the islands. Dr. H. A. Swanson was employed as a dentist for several months, spending part of his time on each island. W. C. Allis, special assistant on St. Paul Island, left there in October for a winter in the south, having been on the island since early in 1919. H. A. Peterson, sealing assistant, arrived on the *Saturn* in June and remained for the winter. Messrs. W. P. Zschorna, F. L. Milligan, O. E. Klockenbrink, M. Syron, and J. H. Quatmann, employees of Funsten Bros. & Co., of St. Louis, spent the summer on the island in connection with experimental work in improving methods of handling and salting seal-skins. Mr. Milligan spent part of his time on St. George Island. Andrew Pearson and Ole Holum, carpenters, were on hand from May until November; the former was continuously on St. Paul Island but the latter was sent to St. George Island for a few weeks.

Ward T. Bower, of the Washington office, visited the islands during the summer for the purpose of getting in closer contact with the activities there, reaching the islands July 1 and leaving July 18. Passage between the islands and King Cove was furnished by the Bureau's vessel *Eider*, and between King Cove and Seattle by commercial vessels.

PURCHASE AND TRANSPORTATION OF SUPPLIES.

As in previous seasons, printed schedules of annual supplies of general merchandise required for the Pribilof Islands were prepared and competitive bids received for the sale and delivery of the goods at Seattle, Wash. Through the courtesy of the Navy Department the radio tender *Saturn* was made available for the transportation of the annual supplies, the vessel making two trips to the islands to complete the work.

On the first trip the *Saturn* had considerable cargo for the radio stations, hence only part of the Bureau's supplies could be taken. On this voyage the vessel sailed from Seattle August 8, carrying 260 tons of general supplies, 77,000 feet of lumber, and 225 tons of coal for St. George Island; and a shipment of empty barrels, 80 tons of coal, and a few tons of general merchandise for St. Paul Island. Owing to unusually severe weather conditions, however, but very little of this cargo was discharged at the Pribilofs, the major portion

being unloaded at Dutch Harbor. The vessel then returned to Bremerton and Seattle, leaving the latter place October 13 with the balance of the supplies. This cargo, and a part of that which had been left at Dutch Harbor, was landed at the islands under adverse conditions. The lumber and some of the coal purchased for St. George Island remained at Dutch Harbor.

During the summer and fall the vessels *Unalga* and *Algonquin* of the Coast Guard very courteously assisted the islands in the transportation of coal and much-needed supplies from Unalaska and Dutch Harbor.

The Bureau's tender *Eider* made a trip to the islands in the month of September and again in October, carrying staple foodstuffs and coal to relieve the shortage which existed until the arrival of the *Saturn* on her second trip.

POWER SCHOONER "EIDER."

The Bureau's power schooner *Eider*, which was purchased and sent to Alaska late in 1919 as a tender for the Pribilof Islands, thoroughly demonstrated its value in the calendar year 1920, making in all 11 round trips between Unalaska and the islands and 2 trips to King Cove from Unalaska before it became necessary in November for the vessel to proceed to Kodiak for certain urgent repairs. All told, 7,959 miles were covered during the year. As Bering Sea is not generally navigated during the winter months and a vessel operating there would be unable to secure assistance in distress, all precautions possible were taken for the safety of the craft during periods of severe weather. Trips to the islands were made as follows: One in January, two in April, one in May, one in June, three in July, one in August, one in September, and one in October. Trips to King Cove were made in June and July.

Early in April the *Eider* transported a special shipment of 1,312 fur-seal skins and 938 fox skins from the islands to Unalaska, from which place they were taken by the commercial steamer *Victoria* to Seattle. The second trip in April from Unalaska to the islands was chiefly to deliver fuel oil for the naval radio stations. During the season the vessel transported general cargo and carried passengers for the radio stations as well as white employees and native workmen of the Bureau's service between Unalaska and the islands, and was also used at St. Paul Island to transfer salted sealskins from Northeast Point to the village. Naval stores were carried on a number of trips by the vessel. The better mail service between the islands and Unalaska, the nearest post office, was of special value.

On October 18 the *Eider* was placed under quarantine for smallpox, of which there was a rather serious outbreak at Unalaska. After the quarantine was lifted the vessel aided in landing cargo from the *Saturn* and otherwise acted as tender for that vessel until again quarantined when a case of smallpox developed aboard the *Eider* November 10. After clearing the second quarantine the *Eider* left for Kodiak November 28 for repairs and to furnish transportation to a physician for St. Paul Island on the return trip. The vessel was at Kodiak at the end of the year.

The officers and crew of the *Eider* deserve commendation for making hazardous trips to the islands during the winter season and at times of the year when no vessel ever before was at the Pribilofs.

DEPARTMENTAL ORDER REGARDING VISITING OF FUR-SEAL ROOKERIES.

For the purpose of definitely regulating the movements of persons temporarily or otherwise present at the Pribilof Islands, the following order was issued by the Secretary of Commerce on March 2, 1920, and the regulations therein were put into effect at the islands during the summer of 1920:

Section 293, Compiled Laws of Alaska, 1913, provides that it shall be unlawful for any person to land or remain on any of the Pribilof Islands, except through stress of weather or like unavoidable cause or by authority of the Secretary of Commerce.

In order that the interests of the Government may be properly served in the matter of protecting the fur-seal rookeries from unnecessary disturbance and in the matter of avoiding the driving of hauling-ground seals into the water, the following regulations are hereby promulgated:

1. Persons lawfully landing, whether to remain temporarily or otherwise, must confine themselves to their lawful activities, and any visiting of rookeries or hauling grounds of seals or sea lions must first be authorized by the Department's agents in charge.

2. In order that persons authorized or permitted to land may have an opportunity to observe seal life, the Department's agents in charge will provide escorts, when practicable, to accompany interested persons to proper observation points. No side digressions from the designated observation points will be permitted. There will be no visiting of rookeries except under such escorts. On St. Paul Island the usual observation point for persons temporarily present shall be what are commonly known as "Observation Rocks" at Gorbachev rookery.

3. Persons authorized to land at St. Paul Island, whether to remain temporarily or otherwise, are required, except under circumstances specifically authorized by the Department's agent in charge, to remain on that portion of the island in and about the village of St. Paul which is bounded by the shore line, including that of the salt lagoon and its outlet, and two straight lines running approximately as follows: The first from the shore at Black Bluffs to the southerly portion of the salt lagoon, passing to the eastward of the natives' cemetery, the natives' wells, and the by-products plant; the second to cut across the isthmus at Zolotoi Sands. The land lines as described will be indicated by notices posted at suitable intervals.

4. Any person willfully violating these regulations will be regarded as a trespasser and will be required to leave the islands at the first opportunity, or will be subject to such other action as may be deemed appropriate.

The above rules have become necessary primarily because of the great importance of nondisturbance of hauling ground seals during the few weeks of active commercial sealing when a thoughtless intrusion upon the seals of that class might mean a large financial loss to the United States. The unnecessary disturbance of seals on their breeding areas is also quite undesirable. Signs designating the limits of the unrestricted district in the vicinity of the village were posted on St. Paul Island, and on St. George Island a definite observation point was selected and marked where visitors, under escort, might see the rookery life without disturbing seals of any class.

CONSTRUCTION WORK.

Considerable construction work has been accomplished at the Pribilofs during the year. On St. Paul Island a new salt house was com-

pleted, a concrete native dwelling was built, and two frame houses for natives were completed. Some of this work had been started the previous year. A garage to house the four tractors on St. Paul Island was built. A concrete extension to the wharf was completed. There is more work to be done along this line as soon as time and funds permit. Various repairs to native dwellings, improvements at the by-products plant, the construction of outhouses, and minor matters were given attention. A road grader was sent to St. Paul Island and some work in improving roads was undertaken.

On St. George Island an extension to the wharf was completed and the landing slip was enlarged, thus facilitating the discharge of small boats lightering cargo ashore. Also some blasting was done at East Landing, thus making possible the construction of a short roadway for handling boats. Preliminary work, including completion of excavation, was done toward the construction of a combined shop and warehouse urgently necessary to provide storage and handling space for the increased take of fox skins. The kenches in the old salt house were transferred to the new salt house, thus bringing sealskin work into a single building. Alterations were made at the fox house to allow trapping, regardless of the direction of the wind.

USE OF TRACTORS.

The four tractors which were forwarded to St. Paul Island on the supply vessel late in 1919 were used during the season of 1920 with satisfactory results. They were employed, with trailers, for general hauling in and about the village, hauling sealskins from the killing fields to the salt houses and moving carcasses to the by-products plant. Also they were found to be of great value in handling the large quantities of lumber, coal, and general cargo landed from the supply ship, and which, owing to the uncertainty of weather conditions in Bering Sea, must be landed and stored as rapidly as possible. In conjunction with a road grader and trailers the tractors rendered good service in the construction of roads.

BY-PRODUCTS PLANT.

The by-products plant on St. Paul Island was operated during a part of the summer of 1920: A shortage of coal made it necessary to close the plant much earlier than had been originally intended. During the period the plant was in operation it produced approximately 19,000 pounds of fertilizer meal and 1,853 gallons of oil, of which 361 gallons were No. 1, 1,299 gallons No. 2, and 193 gallons No. 3. A shipment of 15,393 pounds of meal produced this season was sold at Seattle for \$68 per ton, bringing a total of \$523.36; the remainder of the meal is still at the island. The oil is in storage at Seattle pending decision as to its most advantageous disposition; the market for this product was very poor at the close of the year.

During the summer of 1920 an experiment was conducted to determine the comparative values of oil rendered from the carcasses of seals which had been dead for different lengths of time. It was considered possible that in the cool climate of the Pribilofs the factor of decomposition might be of less consequence than is the case where

animal oils are handled in warmer regions. Accordingly samples were taken of oil rendered from carcasses of seals which had been dead 1, 2, 3, 4, 5, 6, 7, 10, 11, and 12 days, and these were later forwarded to the Bureau of Standards.

The report on the analyses showed that with seal blubber, as in other animal fats, a decided increase in free fatty acids takes place within a very few days. The acid number of the seal oil samples ranged from a minimum of 2.8 for the first two days to a maximum of 13.3 on the tenth day after killing. Reference to the New York market quotations at the end of the year showed a price of 45 cents per gallon for herring oil containing less than 5 per cent of acids, while only 28 cents per gallon was offered for the same oil containing between 5 and 10 per cent of acids. The seal-oil samples taken 10, 11, and 12 days after killing showed an average acid number of 11.2, and the samples for the third, fourth, fifth, sixth, and seventh days had an average acid number of well over 5. In view of the great depreciation in value of oils having a high acid content, it is of primary importance that the oil be rendered from the animal tissues as early as practicable. Other features of the analyses did not show progressive changes on which sound conclusions could be based.

IMPROVED SEALING METHODS.

With a view to securing improvement in the quality of the seal-skins prior to the dressing and dyeing processes, the study of sealing methods at the islands was continued in 1920. W. P. Zschorna, who carried on preliminary work in 1919 for the Bureau, was in charge of experimental work this year for Funsten Bros. & Co. Four other employees of the company, namely, Michael Syron, Oliver E. Klockenbrink, Frank L. Milligan, and J. H. Quatmann, were detailed for duty at the Pribilofs during the active sealing season and assisted in this special work. Particular attention was given the features of blubbering and washing the raw pelts before salting, and of salting the skins only once instead of twice, as formerly. While this work was of an experimental character, it was on a scale sufficiently large to warrant its being used as the basis for making changes if any were found to be desirable.

The method of handling raw sealskins in effect for many years was to allow them to lose their natural heat while lying on the killing field. They were then taken to the salt houses, and at the end of five days were removed, examined for faulty curing, and returned to the salt to await shipment, usually at least five or six weeks later. In the summer of 1920, however, 1,000 skins were given different treatment on St. Paul Island. Immediately after killing, or as soon as they could be hauled in from the killing fields, these skins were cooled in a tank of running sea water; all blubber and meat was carefully removed, they were again washed, and then were stretched and placed in salt to remain until removed for shipment. Advance reports on these skins indicate that they are of such an improved quality as to warrant the extension of the washing, blubbering, and stretching of the pelts to the whole take of skins.

A feature of the new plan is the taking of sealskins by the so-called rough method, which consists in leaving considerable quanti-

ties of blubber and meat on the pelt when it is removed from the animal. In addition to securing more evenly cured skins, the new method does away with the chances for cutting or flaying the skins on the killing field as the subsequent removal of the blubber and meat makes it unnecessary for the skinner to cut close to the pelt. The following comments by the Gibbins & Lohn Dressing & Dyeing Co., of St. Louis, in regard to the blubbered and washed skins of 1920, show some of the practical advantages of the new treatment:

The benefit of the better curing and more uniform condition of the pelts is apparent throughout the various dressing processes. The washing is rendered easier, more efficacious, and safer than on ordinary skins. The better condition of the pelts is also felt in the unhairing process. The hair on the yellow spots is always quite difficult to remove. It is generally necessary on such pelts to loosen the hair by a slight and controlled sweating action, which can not be advantageous, for it has a tendency to loosen fur as well as hair. It was found that in the white-blubbered pelts the hair could be loosened by the unhairing process and the fur left firmer and set tighter when the process was finished. In other words, the hair was easier to remove because the fur held firm. Another result is that more of the fine hair is removed during the unhairing. While this fine hair can be clipped out during the subsequent machining process, a better finished product is obtained if it is removed during the unhairing.

In addition to the skins which were washed and blubbered, a portion of the catch was handled in the usual manner and then cooled by washing before salting; others were given no special treatment beyond a stretching at the time of salting. Various small lots of skins were treated in different ways, the entire effort being toward developing improved methods.

It is probable that the blubbering, washing, stretching, and single salting will be conducted on a larger scale in the season of 1921, as there is every reason to believe that the new methods result in a superior finished product.

NATIVES.

HEALTH CONDITIONS.

The maintenance of good health among the natives on the Pribilof Islands is not only one of the responsibilities resting upon the Bureau in its administration of affairs there, but it is greatly to the interest of the Government to give the best of care to the communities which perform the bulk of the manual labor incidental to the valuable and remunerative industries centering on the islands.

A resident physician is stationed on each of the two islands primarily for the purpose of attending to the health of the natives. Well-stocked dispensaries are provided and a small hospital is available on St. Paul Island. A building to contain hospital facilities is to be constructed on St. George Island in the near future.

During the summer and fall of 1920 a dentist was employed to give attention to the needs of the natives and others on the Pribilofs and he was fully occupied during his entire stay. Another dentist will be secured for the coming year to continue this important work.

It is especially noteworthy that on St. George Island, with a population of about 135 persons, no deaths occurred for a period of 15 months ending June 19, 1920. This is unprecedented in the history of the Pribilofs.

SCHOOLS.

St. Paul Island.—The senior school on St. Paul Island, under the direction of George Haley, was opened on September 22, 1919, and continued until May 28, 1920. The enrollment consisted of 66 pupils. The usual methods were followed in the teaching of the children, particular stress being placed upon subjects which would tend to bring about the increased use of the English language. In resigning at the close of the session, Mr. Haley terminated a period of service in the island schools extending over six years.

St. George Island.—On St. George Island the senior school was opened on October 7, 1919, and closed May 14, 1920, with an enrollment of 34 pupils. The percentages of attendance and punctuality were 99.45 and 99.52, respectively. In discussing the methods of instruction and administration used in the school, Mr. Johnston states:

The pupils were divided into five general classes and again subdivided where necessary. These subdivisions varied with the different subjects of instruction, but were determined more by the intelligence and capabilities of the pupils.

The use of English was always required in the schoolroom. Several days sometimes passed without a word of Aleut being spoken. At recess and at home the pupils were encouraged to speak English.

When the Aleut children can understand English with more ease and quickness, especially as it is spoken, they will advance in their other studies at a surprisingly rapid rate. This inability to understand many explanations given by the teachers, no matter how simple they are, makes such studies as arithmetic difficult. In every recitation the study and use of English was of paramount importance.

In the fourth and fifth reading classes the text was discussed and commented upon by the pupils so that they would understand the English phraseology. The lower classes were given drills in vocabulary and pronunciation. Compositions on stories in the readers were rather poor, as it seemed hard for most of the children to grasp the important points of a story. The following will illustrate: In the geography textbook a paragraph would describe a river system. The final sentence of the description would be: "This is called a river system." The pupils, in spite of continuous instruction, would give the sentence quoted above as the definition of a river system.

Compositions were frequently called for, the subjects being chosen by the pupils or by the teacher. Letters were written to friends at other places. All written work was corrected and handed back to be rewritten or discussed in class.

During the second half of the term the fifth class kept individual diaries. They understood the purpose of the diary easily, and noted many details which most children would not remember. The diaries were examined once a week and individual instruction was given to the writer on his mistakes in grammar, spelling, etc.

It was not necessary to inflict corporal punishment at any time. Standing up in front of the school, staying in at recess, etc., proved sufficient. Strange to say, the pupils did not like to be sent home from school, a fact used to advantage in inflicting punishment.

In addition to the senior school, classes for small children were conducted by Mrs. Ella J. Johnston. This junior school was carried on between the dates given above for the session of the larger school. The enrollment was made up of six girls and five boys. Simple work, similar to that given in kindergarten classes, forms the basis of the work in the junior school. These classes are very valuable in preparing the children for entrance into the senior school and enabling them to take up their work to greater advantage than would otherwise be the case. Mr. Johnston's report comments upon the work of the junior school as follows:

The value of this preparatory course can be realized best by those who take up the child's instruction in the senior school. Last term one of the boys com-

ing to the junior school for the first time was so frightened that he cried lustily until one of his sisters stood beside him. He continued to do this for six weeks. At the end of that time he became interested, and it was hard to persuade him to go home at the end of the period. Without this experience in the junior school, the boy would have caused considerable trouble in the senior school, besides delaying his own advancement.

Sewing classes were also conducted for the larger girls by Mrs. Johnston, various practical stitches being taught. Useful articles, such as sewing bags, needlecases, and aprons were made, and interest was stimulated by the fact that the girls were allowed to keep the articles made.

ATTENDANCE AT SALEM INDIAN TRAINING SCHOOL, CHEMAWA, OREG.

Several native students from the Pribilof Islands are at the Salem Indian Training School at Chemawa, Oreg. None of the pupils returned to the islands, nor were any enrolled during the year; the list of pupils, therefore, remains the same as at the close of 1919.

PRIBILOF ISLANDS NATIVES AT SALEM INDIAN TRAINING SCHOOL, DEC. 31. 1920.

| | |
|------------------------------------|--------------------------------|
| Fratis, Akalina ¹ ----- | Resident of St. Paul Island. |
| Fratis, Ouliana----- | Do. |
| Stepetin, Nicolai----- | Do. |
| Stepetin, Vasilii----- | Do. |
| Lekanof, George----- | Resident of St. George Island. |
| Merculief, Laurence----- | Do. |

Ouliana Fratis has completed a course of study at the school and has since been given the responsibilities of acting as matron in one of the buildings for the smaller girls. It is doubtful whether she or her mother will ever return to the Pribilof Islands.

On November 18, 1920, Agent Crompton made an official visit to Chemawa for the purpose of later making recommendations regarding the policy of sending natives from the Pribilof Islands to that school. The following is extracted from his report:

Rumors had reached the island that the natives who were at Chemawa were not receiving good care, that their food was not plentiful and was of poor quality, and that the sleeping quarters were poorly heated. At first but little attention was paid to these reports, but they became quite persistent and resulted in my request for authority to investigate the matter. In addition there was a question regarding the general policy of sending natives to the States for their schooling.

I arrived at Chemawa late in the evening of November 17, 1920, and spent the entire following day at the school.

The superintendent, Mr. Harwood Hall, showed me through the classrooms of the institution during the forenoon, and the remainder of the day was spent in the various workshops and other buildings.

During the day all of the Pribilof boys were separately questioned regarding their comforts and treatment. They were informed that my visit was for the purpose of hearing their grievances if they had any, but they were unanimous in praise of their treatment, and in addition seemed to have a strong "school spirit" of pride in the institution. The boys were told that if they ever had any real grievances the agents at the Pribilof Islands wished to know of them, but that they should not worry their parents by writing about petty matters. Though I observed closely, nothing seemed to indicate that they were not well cared for in all respects. The food was inspected and the dormitories seen, and all was on an equality with conditions in first-class boarding schools.

¹ Mother of Ouliana Fratis and employed at the school.

The question of sending natives from the Pribilofs to Chemawa, then, becomes one of policy rather than one of doubt regarding the care they might receive while there. In the writer's opinion it is not to the interest of the United States to send them to outside schools, and there is doubt that it adds to the ultimate happiness of the individuals. * * *

It is recommended that no more children be sent to the Chemawa school at the instigation of the Bureau.

SAVINGS ACCOUNTS.

Certain of the Pribilof Islands natives have personal funds in the custody of the United States Commissioner of Fisheries as trustee. These funds are still on deposit with the Washington Loan & Trust Co., Washington, D. C., and draw interest at 3 per cent per annum, calculated on monthly balances.

The condition of the account as a whole on December 31, 1920, is shown in the statement which follows:

| | |
|---|----------------|
| Balance on hand Jan. 1, 1920..... | \$3,093.57 |
| Interest earned from Jan. 1 to Dec. 31, 1920..... | 89.92 |
| | <hr/> 3,183.49 |
| Withdrawn by natives during above period..... | 343.62 |
| | <hr/> 2,839.87 |
| Balance on hand Dec. 31, 1920..... | 2,839.87 |

An itemized statement of the account showing the individual balances of the natives is as follows:

PRIBILOF ISLANDS NATIVES' SAVINGS ACCOUNTS IN CUSTODY OF THE UNITED STATES COMMISSIONER OF FISHERIES, AS TRUSTEE, DEC. 31, 1920.

| ST. PAUL ISLAND. | | | |
|---|---------|-----------------------------------|----------|
| | | Merculieff, Paul A..... | \$15.16 |
| Bourdukofsky, Apollon..... | \$90.42 | Pankoff, Agrippina..... | 235.69 |
| Bourdukofsky, Peter..... | 60.70 | Pankoff, Maria M..... | 43.13 |
| Fratiss, Agrifina ¹ | 92.90 | Sedick, Feofania..... | 13.47 |
| Fratiss, Akalina ¹ | 547.73 | Sedick, Lavrenty..... | 13.47 |
| Fratiss, Martha ¹ | 92.91 | Sedick, Leonty..... | 13.47 |
| Fratiss, Ouliana ¹ | 92.91 | Sedick, Marina..... | .38 |
| Gromoff, Iuliana..... | 348.70 | Tetoff, Vikenty M..... | 43.12 |
| Kozloff, Parascovia..... | 7.28 | | |
| Krukoff, Ekaterina ² | 197.91 | ST. GEORGE ISLAND. | |
| Krukoff, Iuleta..... | 8.90 | Borenien, Zoya ⁵ | 235.97 |
| Mandregan, Alexandra M..... | 10.23 | Galanin, Mary..... | 155.75 |
| Melovidov, Alfey..... | 43.13 | Lestenkof, Michael..... | 118.10 |
| Melovidov, Anton..... | 3.70 | Merculieff, Agrippina..... | 64.54 |
| Melovidov, Iosef..... | 43.13 | Merculieff, Joseph..... | 24.28 |
| Merculieff, Agafia ³ | 38.67 | Merculieff, Polyxenia..... | 12.28 |
| Merculieff, Dosofey..... | 38.67 | Shane, Michael..... | 29.65 |
| Merculieff, Makary..... | 38.67 | Zacharof, Emanuel..... | .45 |
| Merculieff, Mariamna ⁴ | 64.40 | | |
| | | Total..... | 2,839.87 |

PAYMENTS FOR TAKING SEALSKINS.

Following the plan of the two preceding seasons, funds for paying certain persons engaged in the sealing operations at the Pribilofs in 1920 were advanced by Funsten Bros. & Co., and the firm was

¹ Not living on islands in 1920.

² New account; formerly account of Alexey Emanoff, deceased.

³ New account; formerly account of Terenty Merculieff, deceased.

⁴ Includes \$24.98 transferred from account of Auxenia Diakanoff (Mrs. C. H. Hope).

⁵ Includes \$115.14 transferred from account of Mary Philemonof, deceased. Zoya Borenien was formerly Zoya Philemonof; now deceased and estate undivided.

duly reimbursed from the proceeds of the sale of the dressed and dyed skins. Under this arrangement the funds are deposited in a Seattle bank to the credit of the Bureau's authorized and bonded agent at the Pribilofs, who issues checks against the deposit covering accounts payable therefrom.

The practice of paying the island natives for their labor in taking commercial skins was continued. They were paid on the basis of 50 cents each for skins taken from seals up to and including the 6-year-old class, and \$1 each for skins taken from seals of 7 years and upward. No payments are made for labor in taking the skins of seals which are killed primarily for food.

During the calendar year 1920 and through January 31, 1921, the following payments were made from funds advanced by Funsten Bros. & Co.:

| | |
|---|------------------|
| Salaries of sealing assistants, St. Paul Island..... | \$3,079.49 |
| Wages of Aleutian Islands natives at St. Paul Island..... | 4,275.43 |
| Amount earned by St. Paul natives, 1920..... | 11,112.00 |
| Amount earned by St. George Island natives, 1920..... | 2,127.00 |
| Total | 20,593.92 |

In addition to the above total, the sum of \$645 was paid the natives of St. Paul Island during 1920, this amount representing an unpaid credit for the year 1919, which was entered as an undivided credit in the list of expenditures for that year.

Owing to the death of Peter Tetoff, one of the natives at St. Paul Island, there remains an unpaid balance of \$246.50 on account of the sealing work for 1920 on that island; this amount will be paid to the estate of the deceased when it is settled, thus closing the account.

St. Paul Island.—Of the 22,220 skins taken on St. Paul Island during the calendar year 1920, the native workmen received payment for 21,097 skins at the rate of 50 cents each and 710 skins at the rate of \$1 each; the other skins were from seals killed for food for which no payment was made. The fund was divided among the participating natives according to their ability, as follows:

DISBURSEMENTS TO ST. PAUL NATIVES FOR SEALING OPERATIONS, CALENDAR YEAR 1920.

| Classification. | Number of men. | Share of each. | Total. | Classification. | Number of men. | Share of each. | Total. |
|-------------------|----------------|----------------|------------|--|----------------|----------------|------------------|
| First class..... | 28 | \$246.50 | \$6,902.00 | Fifth class..... | 3 | \$99.50 | \$298.50 |
| Second class..... | 13 | 197.50 | 2,567.50 | Additional compensation ¹ | | | 100.00 |
| Third class..... | 7 | 160.00 | 1,120.00 | Total..... | 54 | | 11,358.50 |
| Fourth class..... | 3 | 123.50 | 370.50 | | | | |

¹ Allowed 2 native foremen.

St. George Island.—Of the 4,428 skins taken on St. George Island during the calendar year 1920, 4,030 were paid for at the rate of 50 cents each and 12 at the rate of \$1 each; the balance of the year's take was composed of skins from seals killed for food for which no credit was allowed. The resulting fund was divided among the natives who took part in the operations according to the extent and

proficiency of their work. The division was made as shown in the following table:

DISBURSEMENTS TO ST. GEORGE NATIVES FOR SEALING OPERATIONS, CALENDAR YEAR 1920.

| Classification. | Number of men. | Share of each. | Total. | Classification. | Number of men. | Share of each. | Total. |
|-------------------|----------------|----------------|------------|--|----------------|----------------|----------|
| First class..... | 14 | \$110.00 | \$1,540.00 | Boys' class..... | 3 | \$10.00 | \$30.00 |
| Second class..... | 3 | 79.00 | 237.00 | Additional compensation ¹ | | | 100.00 |
| Third class..... | 1 | 62.50 | 62.50 | Total..... | 24 | | 2,127.00 |
| Fourth class..... | 3 | 52.50 | 157.50 | | | | |

¹ Allowed 2 native foremen.

PAYMENTS FOR TAKING FOX SKINS.

Following the plan of past seasons, natives at the Pribilofs were paid for their labor in taking fox skins during the winter of 1919-20 on the basis of \$5 for each skin secured. The funds are credited to each community as a whole and are later divided among the participating workmen according to the extent and skill of their work. On St. Paul Island 188 skins were taken, resulting in a total credit of \$940 to be divided among 43 men. On St. George Island 750 skins were obtained, making a total credit of \$3,750 to be divided among 30 men. These sums will be paid from the proceeds of the sale of the skins, in February of 1921.

CENSUS.

The usual annual census of native inhabitants of the Pribilof Islands was taken on March 31, 1920. The following recapitulation shows a total of 336 natives accredited to the two islands, 4 of whom are attending the Salem Indian Training School at Chemawa, Oreg. The census of 1920 gives the same number of resident inhabitants for St. Paul Island as were present on March 31, 1919. On St. George Island a gain of 6 inhabitants is shown in the number actually resident:

RECAPITULATION OF CENSUS OF NATIVES, MAR. 31, 1920.

| | |
|---|-----|
| St. Paul Island: | |
| Resident population Mar. 31, 1919..... | 188 |
| Births in year ended Mar. 31, 1920..... | 9 |
| | 197 |
| Arrivals in year..... | 14 |
| | 211 |
| Deaths in year..... | 7 |
| | 204 |
| Departures in year, permanent—To Biorka Island..... | 3 |
| | 201 |

| | |
|--|------------|
| Departures in year, temporary— | |
| To Unalaska | 11 |
| To St. George Island | 2 |
| | <u>13</u> |
| Total native resident population Mar. 31, 1920 | 188 |
| Natives at Salem Indian Training School, Chemawa, Oreg | 4 |
| Others temporarily residing elsewhere | 14 |
| Total natives accredited to St. Paul Island | <u>206</u> |
| St. George Island: | |
| Resident population Mar. 31, 1919 | 122 |
| Births in year ended Mar. 31, 1920 | 8 |
| | <u>130</u> |
| Arrivals in year (from St. Paul Island) | 2 |
| | <u>132</u> |
| Deaths in year | 0 |
| | <u>132</u> |
| Departures in year, permanent—To Seattle, Wash | 1 |
| | <u>131</u> |
| Departures in year, temporary— | |
| To Chemawa, Oreg | 1 |
| To St. Paul Island | 2 |
| | <u>3</u> |
| Total native resident population Mar. 31, 1920 | 128 |
| Natives at Salem Indian Training School, Chemawa, Oreg | 2 |
| Total natives accredited to St. George Island | <u>130</u> |

FUR-SEAL HERD.

QUOTA FOR KILLING.

On May 26, 1920, the Bureau made recommendation to the Secretary of Commerce regarding the number of male seals which might be authorized for killing at the Pribilof Islands during the calendar year 1920. The Bureau's recommendation, approved by the Secretary May 26, 1920, was as follows:

QUOTA OF SEALS FOR KILLING IN 1920.

| Age class. | St. Paul. | St. George. | Total. |
|----------------------------|-----------|-------------|--------|
| 3-year-olds | 15,830 | 2,900 | 18,730 |
| 4-year-olds | 4,400 | 1,100 | 5,500 |
| 7-year-olds and over | 10,770 | | 10,770 |
| Total | 31,000 | 4,000 | 35,000 |

The foregoing figures are those which were given the Bureau's representatives at the Pribilofs for their general guidance, the numbers to be killed being subject to revision should conditions observed at the islands during the progress of operations indicate

the necessity therefor. As the season advanced it seemed wise to modify the original instructions, and accordingly, on July 22, the Acting Secretary of Commerce authorized the killing of 3,000 more seals of the 3-year-old class and 1,000 of the 4-year-old class. This was later modified to include only those seals of the 3-year-old class whose length was 43 inches or over. The instructions were conveyed by telegraph.

Killings of previous years having reduced the numbers of seals in the 5-year-old and 6-year-old classes of 1920 rather close to the reserve required by law, it was thought best not to draw further on these classes. A return to the desirable proportion of adult males to females is now reported on both islands, and upon the recommendation of the superintendent at St. Paul Island the killing from this class was stopped on July 23, after 703 skins had been secured.

KILLINGS OF SEALS.

St. Paul Island.—In a total of 54 drives during the period from January 22 to November 29, inclusive, 22,220 seals were secured on St. Paul Island during the calendar year 1920.

St. George Island.—The first drive was made on St. George Island on May 31 and the last on November 19; in a total of 35 drives, 4,428 seals were killed during the calendar year 1920.

The total number of seals killed on both islands during the calendar year was 26,648. Details regarding the killings are shown in the following tables:

SEAL KILLINGS ON PRIBILOF ISLANDS IN 1920.

ST. PAUL ISLAND.

| Date. | Serial No. of drive. | Hauling ground. | Skins so-cured. | Date. | Serial No. of drive. | Hauling ground. | Skins so-cured. |
|---------|----------------------|--|-----------------|---------|----------------------|--|-----------------|
| Jan. 22 | 1 | Sea Lion Rock..... | 68 | July 17 | 30 | Morjovi and Vostochni.... | 1,344 |
| Jan. 30 | 2 |do..... | 4 | July 19 | 31 | Reef and Gorbatch..... | 1,309 |
| May 18 | 3 |do..... | 58 | July 20 | 32 | Zapadni, Little Zapadni, and Zapadni Reef. | 466 |
| June 4 | 4 |do..... | 97 | July 21 | 33 | Tolstoi, Lukanin, and Kitovi. | 251 |
| June 11 | 5 | Reef..... | 225 | July 23 | 34 | Reef and Gorbatch..... | 697 |
| Do.... | 6 | Tolstoi..... | 85 | July 27 | 35 | Morjovi and Vostochni.... | 1,432 |
| June 14 | 7 | Morjovi..... | 417 | July 29 | 36 | Gorbatch..... | 428 |
| Do.... | 8 | Vostochni..... | 41 | July 30 | 37 | Reef..... | 259 |
| June 19 | 9 | Zapadni..... | 357 | Do.... | 38 | Lukanin and Kitovi..... | 89 |
| June 21 | 10 | Reef..... | 541 | Aug. 2 | 39 | Tolstoi..... | 210 |
| June 23 | 11 | Morjovi and Vostochni.... | 574 | Aug. 3 | 40 | Zapadni, Little Zapadni, and Zapadni Reef. | 225 |
| June 24 | 12 | Polovina..... | 295 | Aug. 4 | 41 | Morjovi and Vostochni.... | 406 |
| June 25 | 13 | Tolstoi..... | 242 | Do.... | 42 | Gorbatch..... | 257 |
| Do.... | 14 | Lukanin..... | 114 | Aug. 5 | 43 | Polovina..... | 323 |
| June 26 | 15 | Zapadni..... | 391 | Aug. 6 | 44 | Tolstoi..... | 70 |
| June 28 | 16 | Reef and Gorbatch..... | 1,127 | Do.... | 45 | Lukanin and Kitovi..... | 40 |
| June 30 | 17 | Morjovi..... | 536 | Aug. 7 | 46 | Zapadni..... | 49 |
| Do.... | 18 | Vostochni..... | 496 | Aug. 8 | 47 | Reef and Gorbatch..... | 101 |
| July 1 | 19 | Polovina..... | 270 | Aug. 10 | 48 | Polovina..... | 143 |
| July 2 | 20 | Tolstoi..... | 315 | Do.... | 49 | Morjovi and Vostochni.... | 257 |
| July 3 | 21 | Reef and Gorbatch..... | 840 | Oct. 23 | 50 | Reef..... | 175 |
| July 5 | 22 | Zapadni, Little Zapadni, and Zapadni Reef. | 421 | Nov. 9 | 51 |do..... | 34 |
| July 7 | 23 | Morjovi and Vostochni.... | 2,660 | Do.... | 52 | Lukanin..... | 23 |
| July 9 | 24 | Lukanin and Kitovi..... | 99 | Nov. 20 | 53 | Reef..... | 34 |
| Do.... | 25 | Tolstoi..... | 399 | Nov. 29 | 54 | Gorbatch..... | 18 |
| July 10 | 26 | Reef and Gorbatch..... | 1,333 | | | | |
| July 11 | 27 | Zapadni, Little Zapadni, and Zapadni Reef. | 669 | | | | |
| July 14 | 28 | Reef and Gorbatch..... | 1,181 | | | Total..... | 22,220 |
| Do.... | 29 | Tolstoi, Lukanin, and Kitovi. | 382 | | | | |

SEAL KILLINGS ON PRIBILOF ISLANDS IN 1920—Continued.

ST. GEORGE ISLAND.

| Date. | Serial No. of drive. | Hauling ground. | Skins se- cured. | Date. | Serial No. of drive. | Hauling ground. | Skins se- cured. |
|---------|-------------------------------|---|------------------------|---------|-------------------------------|----------------------------|------------------------|
| May 31 | 1 | North..... | 5 | July 13 | 19 | Zapadni..... | 36 |
| June 7 | 2 | East Cliffs and Staraya Artil..... | 22 | July 15 | 20 | North and Staraya Artil.. | 206 |
| June 9 | 3 | North..... | 26 | July 17 | 21 | East Reef..... | 354 |
| June 12 | 4 | East Cliffs..... | 20 | July 19 | 22 | North and Staraya Artil.. | 224 |
| June 16 | 5 | North, Staraya Artil, and East Cliffs..... | 131 | July 22 | 23 | East Reef and North..... | 430 |
| June 19 | 6 | East Cliffs..... | 11 | July 24 | 24 | North and Staraya Artil.. | 277 |
| June 21 | 7 | North and Staraya Artil.. | 100 | July 26 | 25 | East Reef..... | 103 |
| June 25 | 8 | East Cliffs and North..... | 58 | July 29 | 26 | North and Staraya Artil.. | 269 |
| June 28 | 9 | East Reef and North..... | 117 | July 31 | 27 | East Reef..... | 163 |
| June 29 | 10 | Zapadni..... | 58 | Aug. 2 | 28 | North and Staraya Artil.. | 26 |
| June 30 | 11 | Staraya Artil..... | 130 | Aug. 4 | 29 | East Reef and North..... | 80 |
| Do..... | 12 | North..... | 88 | Aug. 9 | 30 |do..... | 104 |
| July 3 | 13 | East Reef..... | 11 | Oct. 20 | 31 | East Cliffs and North..... | 199 |
| July 5 | 14 | North..... | 170 | Oct. 23 | 32 |do..... | 53 |
| July 6 | 15 | Zapadni..... | 37 | Nov. 2 | 33 |do..... | 53 |
| July 7 | 16 | East Reef and North..... | 175 | Nov. 17 | 34 | North and Staraya Artil.. | 69 |
| July 10 | 17 | North and Staraya Artil.. | 521 | Nov. 19 | 35 | East Cliffs..... | 12 |
| July 12 | 18 | East Reef..... | 90 | | | Total..... | 4,428 |

AGE CLASSES OF SEALS.

The present method of classifying seals of unknown age has been developed from experimental work conducted since the summer of 1912, when a large number of male and female pups of that season were branded with a permanent distinctive mark. A few of these animals have been killed in each season since 1912 and the body lengths—from tip of nose to root of tail—and other data have been recorded. On the basis of the growth attained by these seals in each of the several years, limits of carcass length have been adopted for each year of age, and seals are now classified in accordance with the position their respective carcass lengths occupy in the scale taken from the branded animals. The limits now in use are as follows:

AGE STANDARDS OF BODY LENGTHS OF SEALS.

| Age. | Lengths of summer seals. | Lengths of fall seals. | Age. | Lengths of summer seals. | Lengths of fall seals. |
|------------------|-----------------------------|---------------------------|------------------|-----------------------------|---------------------------|
| | <i>Inches.</i> | <i>Inches.</i> | | <i>Inches.</i> | <i>Inches.</i> |
| Yearlings..... | Up to 36.75 | Up to 38.75 | 4-year olds..... | 46 to 51.75 | 48 to 53.75 |
| 2-year olds..... | 37 to 40.75 | 39 to 42.75 | 5-year olds..... | 52 to 57.75 | 54 to 59.75 |
| 3-year olds..... | 41 to 45.75 | 43 to 47.75 | 6-year olds..... | 58 to 63.75 | 60 to 65.75 |

AGES OF SEALS KILLED ON PRIBILOF ISLANDS, CALENDAR YEAR 1920.

| Age. | Summer (Jan. 1-Aug. 10), 1920. | | | Fall (Aug. 11-Dec. 31), 1920. | | | Grand total. |
|---------------------------|-----------------------------------|----------------|--------|----------------------------------|----------------|--------|-----------------|
| | St. Paul. | St. George. | Total. | St. Paul. | St. George. | Total. | |
| Yearlings..... | 7 | | 7 | | | | 7 |
| 2-year olds..... | 166 | 194 | 360 | 2 | 26 | 28 | 388 |
| 3-year olds..... | 15,914 | 2,917 | 18,831 | 233 | 312 | 545 | 19,376 |
| 4-year olds..... | 4,988 | 843 | 5,831 | 46 | 44 | 90 | 5,921 |
| 5-year olds..... | 45 | 61 | 106 | 2 | 3 | 5 | 111 |
| 6-year olds..... | 39 | 4 | 43 | | | | 43 |
| 7-year olds and over..... | 709 | 12 | 721 | 1 | | 1 | 722 |
| Cows ¹ | 68 | 11 | 79 | | 1 | 1 | 80 |
| Total..... | 21,936 | 4,042 | 25,978 | 284 | 386 | 670 | 26,648 |

¹ The few cows reported above, about one-third of 1 per cent. of the total take, were accidentally and unavoidably killed. Every possible effort is made to avoid the killing of cows, but persons familiar with conditions at the islands will readily appreciate that once in a great while a cow is killed.

BRANDED SEALS.

Fifteen 8-year-old male seals, bearing the brand placed upon them as pups in 1912, were killed during the calendar year 1920. Of this number six were taken on St. Paul Island and nine on St. George Island.

It is from the 1912 series of branded seals that the data were obtained from which the age classification standards now in use were developed. Observations have also been made as to the development and movements of female seals bearing the 1912 brand. It is believed that more dependable information has been obtained as a result of the branding done in 1912 than from any similar work done in the past.

The following table shows certain information secured from the animals killed this season:

RECORDS OF BRANDED 8-YEAR-OLD MALE FUR SEALS KILLED ON PRIBILOF ISLANDS, CALENDAR YEAR 1920.

| Serial No. of skin. | Date of killing. | Island. | Carcass weight. ¹ | Carcass length. | Green- skin weight. | Trade classifi- cation. |
|---------------------------|---------------------|-----------------|---------------------------------|--------------------|---------------------------|-------------------------------|
| | 1920 | | <i>Pounds.</i> | <i>Inches.</i> | <i>Pounds.</i> | |
| AP6828 | June 28 | St. Paul..... | 282 | 59.50 | 151 ² | Wig. |
| AP6829 | July 10 | do..... | 288 | 70.00 | 27 | Do. |
| AP6830 | July 14 | do..... | 309 | 72.75 | 50 | Do. |
| AP6831 | July 23 | do..... | 271 | 73.25 | 41 | Do. |
| AP6885 | Aug. 4 | do..... | 251 | 69.25 | 27 | Do. |
| AP7380 | Oct. 23 | do..... | 297 | 73.50 | 33 | Do. |
| G6150 | June 21 | St. George..... | 249 | 69.25 | 24 | Do. |
| G6158 | July 5 | do..... | 351 | 72.25 | 38 | Do. |
| G6159 | July 15 | do..... | 260 | 69.50 | 37 | Do. |
| G6160 | July 19 | do..... | 243 | 68.25 | 23 | Do. |
| G6161 | do..... | do..... | 273 | 69.25 | 35 | Do. |
| G6162 | do..... | do..... | 286 | 73.00 | 43 | Do. |
| G6163 | July 22 | do..... | 259 | 73.50 | 37 | Do. |
| G6164 | Aug. 9 | do..... | 322 | 75.50 | 32 | Do. |
| G6165 | do..... | do..... | 252 | 72.00 | 42 | Do. |

¹ Seals were bled before being weighed.

The above table presents information comparable with that secured from the branded seals of 1912 killed in past years. These earlier

data may be obtained by reference to the Alaska fisheries and fur industries reports for the years since the branding was done.

In order to add to the data already secured, it is the purpose of the Bureau to kill some of these male seals in each of the years they may continue to exist, but to insure an adequate remainder for observation during that period it will probably be necessary to reduce the number to be killed to three or four animals in each season.

CENSUS.

Following the practice of previous years a census of the fur-seal herd was taken in the summer of 1920. Details are contained in the report, printed on pages 104 to 120, by Dr. G. Dallas Hanna, who has been in local charge of the census work for a series of years beginning in 1915. Edward C. Johnston, storekeeper on St. George Island, assisted in the actual census work in 1920 on both islands. The growth of the herd from year to year renders it increasingly difficult to enumerate the animals, but, on the other hand, the observations of each year add to the concrete information available as a basis of computation and enable the determination of relatively accurate percentages of loss for the different age classes.

The following is a comparative statement of the numerical strength of the various elements of the herd in the years 1912 to 1920, inclusive:

GENERAL COMPARISON OF RECENT CENSUSES OF THE SEAL HERD.

| Class of seals. | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Harem bulls..... | 1,358 | 1,403 | 1,559 | 2,151 | 3,500 | 4,850 | 5,344 | 5,158 | 4,066 |
| Breeding cows..... | 81,984 | 92,269 | 93,250 | 103,527 | 116,977 | 128,024 | 142,915 | 157,172 | 167,527 |
| Surplus bulls..... | | | | | | 8,977 | 17,110 | 9,619 | 6,115 |
| Idle bulls..... | 113 | 105 | 172 | 673 | 2,632 | 2,706 | 2,444 | 2,239 | 1,161 |
| Young bulls (chiefly 5-year-olds)..... | 199 | 259 | 1,658 | | | | | | |
| 6-year-old males..... | | | | | 11,167 | 15,397 | 13,755 | 8,991 | 4,153 |
| 5-year-old males..... | | | | 11,271 | 15,494 | 14,813 | 11,941 | 5,282 | 5,007 |
| 4-year-old males..... | 100 | 2,000 | 9,939 | 15,848 | 15,427 | 16,631 | 7,114 | 5,747 | 5,667 |
| 3-year-old males..... | 2,000 | 10,000 | 13,880 | 18,282 | 19,402 | 19,507 | 9,117 | 13,596 | 10,749 |
| 2-year-old males..... | 11,000 | 15,000 | 17,422 | 23,990 | 24,169 | 26,815 | 30,159 | 33,081 | 39,111 |
| Yearling males..... | 13,000 | 20,000 | 23,068 | 30,307 | 33,645 | 38,013 | 41,595 | 46,444 | 51,074 |
| 2-year-old cows..... | 11,000 | 15,000 | 17,422 | 23,990 | 24,245 | 26,917 | 30,415 | 33,287 | 39,480 |
| Yearling cows..... | 13,000 | 20,000 | 23,067 | 30,306 | 33,646 | 38,018 | 41,608 | 46,447 | 51,081 |
| Pups..... | 81,984 | 92,269 | 93,250 | 103,527 | 116,977 | 128,024 | 142,915 | 157,172 | 167,527 |
| Total..... | 215,738 | 268,305 | 294,687 | 363,872 | 417,281 | 468,692 | 496,432 | 524,235 | 552,718 |

SPECIMENS FOR SCIENTIFIC PURPOSES.

For use in the preparation of a natural history group at the American Museum of Natural History in New York, several specimens of fur seals were collected at the Pribilofs during 1920. Thirteen skins were furnished the museum, one from an adult bull and eight from pups, all found dead on St. Paul Island, and one from a pup found dead and three from cows unintentionally killed in the sealing work on St. George Island. The collection was appraised at \$29, which amount was paid by the museum and properly deposited in the United States Treasury.

FOXES.

The foxes on the Pribilof Islands have regularly been the source of considerable revenue to the United States. The animals run at large on both islands and call for scarcely any outlay of funds and comparatively little labor.

One of the paradoxical features of the fox life on these islands is that the larger island, with a greater abundance of seal meat and more accessible beaches, has constantly furnished a smaller number of skins than St. George Island. Immediate conditions can not be assigned as the reason for this peculiar difference because of the fact that the situation has remained the same over a period of more than 40 years. Methods of feeding adopted on St. George Island in more recent years have caused a still greater contrast in the size of the catches on the two islands.

In the assumption that the foxes obtain sufficient food from the seal bodies remaining on the killing fields and from the natural food on the seashore, no special effort to feed the animals is made on St. Paul Island. The foxes are trapped with common steel traps during a short season in the early winter. When possible it is always planned to do this trapping before the heavier snowfalls take place, so that the runways may be observed and the traps placed on the ground. The time for trapping is usually selected with respect to the condition of the ground surface and the outlook of the weather.

TRAPPING SEASON OF 1920-21.

During the trapping season of 1920-21 a total of 1,125 blue and 14 white fox skins was taken on the two islands. Of this number 123 blue and 13 white skins were taken on St. Paul Island and 1,002 blues and 1 white on St. George. In addition, there were reserved for breeding purposes on the latter island 242 male and 240 female foxes, making a grand total of 1,485 animals handled there during the winter. The above take is the largest since the winter of 1892-93 when 373 animals were caught on St. Paul Island and 928 on St. George; during that year no reservation of breeders was made, however. The gain in this season's take, as in several past, comes entirely from St. George Island where the herd has been growing rapidly for a number of years.

With respect to the methods in use at St. George Island, Agent C. E. Crompton has recently submitted a detailed report as follows:

METHODS EMPLOYED IN THE MANAGEMENT OF THE BLUE FOXES ON ST. GEORGE ISLAND, ALASKA.

The blue foxes of St. George Island, Alaska, are the stock of what is probably the most successful fox farm in the country at the present time, if not the most promising in the world. The history of the ebb and flow of fox life on that island and the relation of that fluctuation to the influences which man has directly or indirectly brought to bear form a very interesting nature study.

History states that the furs of the seals, sea otters, and foxes were much exploited during the years immediately following the Russian discovery of the island, but no authentic records prior to 1840 are available. James Judge states that during the 19 years ending with 1860 the average annual catch was over 1,200 animals; during the first 19 years of the American tenure of the island the average catch was approximately 1,000 each season. Trapping was conducted during but four of the six winters from 1890 to 1896, inclusive, and

with such poor results that a total of only 2,325 pelts was secured. These latter years mark the most important changes in the history of the herd.

During the years preceding 1896 the foxes had always been forced to seek their winter food from the summer's accumulation of fur-seal carcasses on the killing fields, and up to the year 1885 had probably secured an abundance of food therefrom. Coincident with the decline of the seal herd, however, and particularly during the *modus vivendi* of 1891-1893, which restricted the land killing of seals to 7,500 annually, pending the award of the Tribunal of Fur-Seal Arbitration at Paris, the number of foxes became rapidly smaller. The situation, however, was not immediately recognized as a shortage of food, the agents of the Government placing the blame on excessive trapping by the lessees.

The state of affairs was probably first seen in its true light by Treasury Agent James Judge, who, in the summer of 1896, prepared a quantity of surplus seal meat by lightly salting and storing the food in the manner of ensilage. The experiment was successful, and Mr. Judge immediately recognized the possibility of selective killing by catching the animals in box traps instead of the steel traps which had always been used theretofore. A trapping house, with a wire cage adjoining, was the final outcome of the above-described experiment. The foxes came readily to the cage to obtain the much-needed food and were caught when the cage door was closed by a rope leading from within the house.

The methods of trapping outlined in the following pages are based on the work of James Judge, to whom much credit is due. That his principle was right and that it has been properly carried out was shown by the catch of 1919-20, when 750 pelts were secured and 454 animals released as breeders; the largest number of skins obtained since 1892-93, and, with a single exception, the largest total of animals caught in any season since the inauguration of the present system.

Food.

The natural food of the blue fox of the Pribilof Islands is made up of birds, eggs, insects, berries, miscellaneous bits of animal matter cast up by the sea, and occasionally dead seals, sea lions, walruses, or whales. While such food is plentiful during the milder seasons, it is reduced to the single item of beach food during the winter, when the shore is at times in the grip of frozen spray for long periods. Drift ice also closes the beaches for days at a time and usually large deposits of ice are left stranded, and these hinder the foxes in their search for food. It is at once apparent that comparatively few animals would survive a severe winter without a reserve supply of food.

In ordinary seasons the foxes of St. George Island are dependent upon a reserve supply of seal meat as food from September 15 to April 30. These dates are very safe and they will, of course, vary as the seasons are mild or severe, early or late, but will in most instances mark the period of need. "Open" or unfrozen beaches during the winter time often furnish much additional food, and during such intervals the foxes feed but lightly on the seal meat. On the other hand, a protracted period of cold prevents the animals from obtaining the natural food of the seashore, and they then visit the feeding ground in large numbers, consuming surprising quantities of meat. This feeding is necessary by reason of the fact that there are on the island at the present time many more foxes than the comparatively small supply of natural food in the winter season can support, and the size and rate of growth of the herd are primarily limited by the number which can be sustained during that trying period.

Preparation of food.—Seal meat has been found to be a successful and most readily obtainable food for use as a reserve. The foxes use all the seal meat which is not consumed by the native inhabitants of the island. After a killing of seals has been made the natives cut up the carcasses, remove the choicest portions for their own immediate and future needs, and the surplus is stored for winter fox food. At a suitable time (usually the day following the killing) the carcasses are eviscerated and emptied of free blood clots to retard putrefaction. If large, the carcasses are cut into sections, but if the seals are of a size readily handled they may be stored whole. It is not a good practice to store the meat before it has cooled, nor should it be left on the field through a hot, sunny day.

The carcasses are deposited in a large pit or silo, which is cut into the side of a hill of hard, scoriaceous earth. The outer side of this pit is bulkheaded

with strong planks and a small doorway, closed by means of flashboards, is placed near the center of the base of the bulkhead. This door serves both as a drain for the effluent water and oil and as a port from which the meat may be drawn as needed.

As the meat is thrown into the pit it must be spread about evenly and sprinkled with a small amount of half-ground salt. Salt which has already served a part of its usefulness in the sealskin kenchies is entirely satisfactory for salting fox food. It is of great importance to have the meat spread in such a manner as to leave as little air space as possible; the principle is primarily that of ensiling rather than salting. It is surprising how well the meat will be preserved with but very little salt if the air is properly excluded.

After the summer's sealing has been completed the silo is covered with a sectional hatch, which rests on the edges of the pit. It is not of advantage to store the seal meat resulting from the fall killings, as the natives take large quantities for salting and freezing and the foxes will consume the fresh remains in a short time.

Before the feeding of the reserve food begins it should be freshened by the passage of fresh water through the pit. This is done by laying a pipe line to a siphon, which draws the water from a lake near by. The water should run at least two weeks steadily, but must not be turned on until the time for feeding draws near, else the food will begin to decompose unnecessarily.

Feeding.—Having decided that feeding should begin, a supply of the prepared meat is removed from the silo to the food kenchies in the trapping house, where it may be drawn upon with ease as required. The native foreman is then instructed to put out a small experimental amount in the neighborhood of the building and to report the following morning as to the quantity consumed. Upon receiving this report the agent will know how to proceed the following evening. It is a commendable practice to provide for a remainder of food each morning, except during the active trapping season, when the animals must not become satiated. The foreman details a single workman to the work of setting out the food for a week at a time, after which that man is relieved by some one who does the work for a similar period.

The feeding is continued in the neighborhood of the trapping building until two weeks or more before it is expected to begin trapping, at which time it is placed within the cage. Much smaller quantities of food are then put out, and it may be well, in the case of a mild season, to suspend feeding for a day or two, putting out only enough food to attract the animals to that vicinity. This must be decided and gauged by the manner in which the foxes have been feeding during the interval immediately preceding, and it is largely a matter of judgment.

When the beginning of trapping has been decided upon all waste bits of meat and bone are gathered together and stored in barrels in an inaccessible place, where they will not draw the foxes from the lure within the cage. After trapping has started, food is placed only within the cage and the accumulation of bones therein is cleaned out from time to time and disposed of as stated above. Bits of food which have been dragged outside the cage must not be allowed to accumulate, as the more timid foxes will feed on them in preference to entering the cage.

Trapping.

Season.—The season for trapping prime-furred foxes varies in direct relation to the degree and duration of cold weather. Ordinarily the best of the pelts will be secured between December 1 and February 1, though prime furs may be taken on either side of these extremes.

Toward the latter part of November a few foxes may be caught and the fur examined as to its marketable condition. The extent of growth of the guard or crown hairs is a very good guide, as when these hairs have reached a length extending well beyond the heavier fur the pelt takes on its well-known silkiness and luster so highly valued by the trade. The guard hairs are seldom, if ever, fully extended before the fur beneath has become prime. Many skins vary as to fur; some have a heavy growth of dark fur, while others may have comparatively thin coats of light color, but the primeness consists in a uniform growth of whatever class of fur the animal happens to have, accompanied by the full growth of guard hairs. Animals are occasionally seen with no visible growth of guard hairs, but these are presumed to be diseased and are so few in number as to be negligible.

During mild seasons it will be noted that some of the pelts have a decided reddish tinge to the guard hairs, and while the exact effect of this condition is not known to the writer, it appears that its presence is not of sufficient importance to warrant the cessation of trapping. In the two seasons of 1915-16 and 1919-20 this "rusty" condition was particularly noticeable, but on both of these occasions the furriers subsequently stated that the value of the skins was but slightly lessened thereby. While the darkest furs are the most desirable, a good pelt commands a fair price even though the reddish tinge is in evidence.

The approach of the end of the season and the lapse of primeness in the skins can not be determined by any rule. The condition of the fur must be carefully watched, for rubbed or felted patches about the throat or rump are a certain indication of unprimeness. The observations must naturally be made before the fox is killed.

Weather conditions.—There is probably no single indirect factor having a more important bearing on the outcome of the season's trapping than that of weather. Clear, cold nights, with moderate winds from points in the north or east, are the conditions under which trapping may best be conducted at the village. Western winds favor the Zapadni cage. High night tides are advantageous, low ones the contrary. While moonlight makes the trapping work easier, the animals may be seen without difficulty on the darkest night if there is a little snow on the ground. The lower the temperature and the longer the period of cold, the more favorable is the situation; the cold keeps the beaches frozen and the continuation of it forces the most timid animals to visit the cage in search of food. Storms do not necessarily preclude trapping if the winds are from favorable directions and are not exceedingly strong. Wet snow or rain is unfavorable, as the furs become wet and soiled on such occasions; this dampness is very undesirable when the skins are made ready for stretching. Trapping may, however, be conducted with fair results during mild weather when rain is not falling. Persistence is required if a large catch is to be made.

Location of traps.—Two cage traps are used at the present time, one at the village, the second at Zapadni. The advisability of installing a third is doubtful. The second trap was the natural outcome of the feeding of foxes at Zapadni and it is useful when winds are unfavorable for work at the village. The desirability of securing the largest number of pelts at the village trap is readily seen.

The village trap is the original building set up by James Judge shortly after his experiment of 1896, and, like all cage traps, it is near the shore line. The second is simply a wire cage set up in 1919 close by the Zapadni watch house. Efforts are occasionally made to secure foxes at Garden Cove (on the southern shore) by means of string or noose traps, but the results are quite disproportionate to the labor involved. It should also be mentioned that the foxes having their homes in the immediate vicinity of the village form a distinct colony, the members of which rarely visit the cage trap and must be obtained by noose traps placed within the village and operated from the windows of the village buildings.

Description of traps.—Herewith is a diagram showing the arrangement of the village trap. The drop door "F," sliding in a groove, is operated by a man stationed within the darkened room "B," who watches the animals through the small window "H," which commands a view of the trap interior. The Zapadni trap is on the same general plan, the cage standing apart from the house and being operated from the window. At Zapadni the foxes must be caught and removed from the trap by hand, while at the village it is much more readily done, as will be seen later.

The noose trap is a very simple arrangement. A small doorway is cut in the end of a common packing case, which is then placed with its open face to the ground, the door remaining open on the end of the case. Some bait having a strong odor, such as old seal meat or seal oil, is placed within the box, and a noose is hung about the doorway. As the fox endeavors to investigate the contents of the box, the noose is closed about his neck by an operator stationed within a near building. This trap is an unsatisfactory arrangement to use outside the precincts of the village, as when an animal is captured the resulting commotion frightens other foxes away from that neighborhood. Furthermore, but a single fox can be caught at each operation.

Operation of traps.—It must be borne in mind during the trapping season that the foxes are largely dependent upon the seal meat for their sustenance,

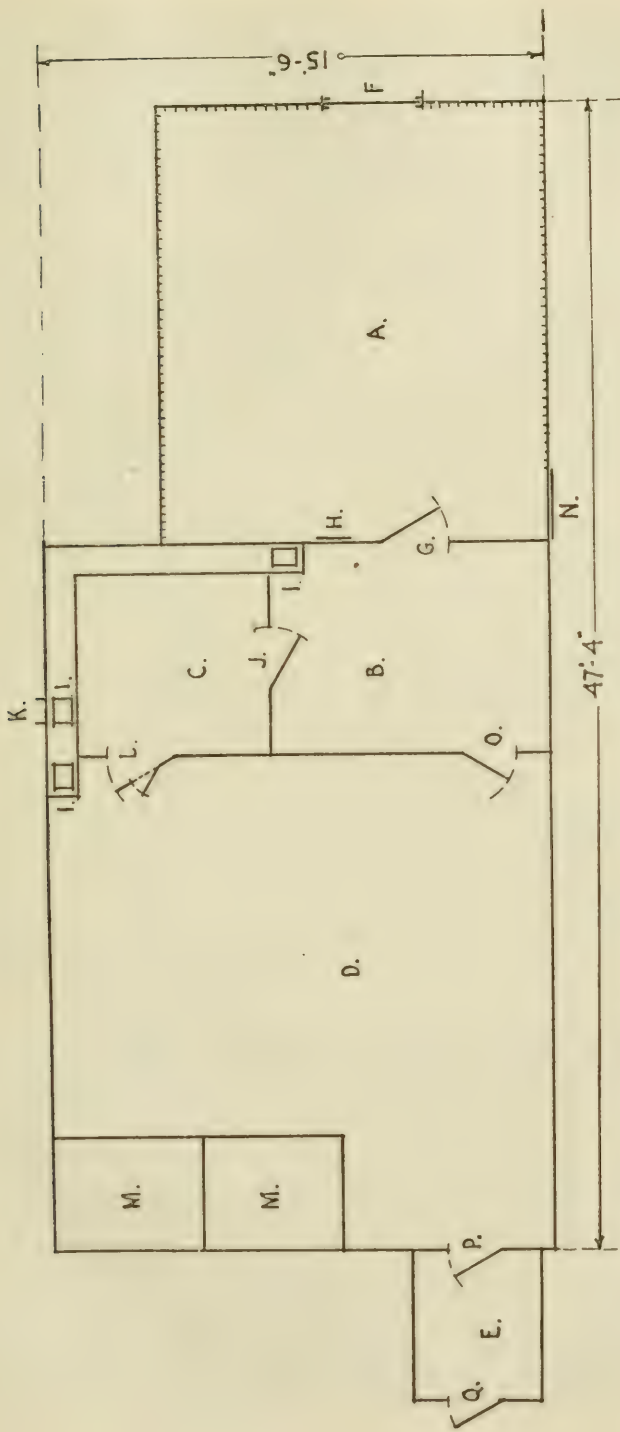


FIG. 1.—INTERIOR ARRANGEMENT OF FOX-TRAPPING HOUSE.

and, while large numbers of animals visit the cage in the morning after an evening's trapping, continuous operation of the trap over too long a period will cause the foxes to abandon their trips to the cage for food. Such a practice forces the foxes to search for food elsewhere and also prevents any record being made of those animals, either for their pelts or as breeders. The more timid foxes may be seen to wander about the trap for long periods before entering, and each time the trap is sprung these animals are frightened off. The writer believes that the trap should be left open to the foxes at least two full nights in seven, and if all-night trapping is practiced the feeding nights should be increased to three in each week. These precautions are not so necessary if the beaches are unfrozen.

The actual trapping of the foxes may be begun as early as 4.30 p. m. and continued as late as seems desirable. A responsible native, with an assistant, takes up his position in the trapping room opposite the small window and opens the sliding door by means of a rope. The opening of the door by the trapper exposes the food for the first time on any trapping night, so that no foxes will have previously satisfied their hunger. The trapper maintains a constant watch of the trap, and when several foxes are in the cage he lowers the door and imprisons them. This moment for dropping the door must be properly judged. There should be no foxes so near the door that they will be in danger of injury when it drops; the door should not be closed in the face of animals too near the trap, as they would only be unnecessarily frightened thereby; on stormy nights the door may be so carefully closed that even the foxes within the trap are not aware of the change. Only responsible natives should ever be left in charge of the trap rope; such men understand the foxes and do the work well.

After closing the trap the operator sends his assistant into the cage and the foxes are driven through the open doors "G" and "J" into the retaining room "C," where they are held until a sufficient number has been caught to warrant further attention. After closing the doors to the retaining and trapping rooms the cage door is raised and the operation is repeated.

Handling of animals.—It is not advisable to hold more than 20 foxes in the retaining room at one time, as the animals have a tendency to clamber about and will pile up and become overheated, particularly in mild weather. On the opening night of the season the foxes can be caught almost as rapidly as the skins can be handled, the trap taking as high as 10 or 12 in a single operation. Later in the season the more timid foxes appear and only 2 or 3 are taken at intervals of an hour or more.

When a suitable number of foxes has been caught, the skimmers and other men take up their places in the large room "D" and the work begins. Two or three men, armed with forked sticks, are sent into the retaining room, where they catch the foxes by pressing them down to the floor until a proper hold has been secured with the hands; the animal is grasped about the neck from behind. This work must be done with as much care as is consistent with a fair degree of speed, as some of the animals are to be reserved as future breeders and must not be injured by unnecessarily rough handling. If any marked breeders are found, they are liberated through the door "I" and the exit "K."

After catching the fox the native passes it through the opening in the special door "L," whereupon a man on the opposite side takes it from him, holding the animal in the same manner. Another man examines the fox and calls out its sex that it may be written down by the agent. The latter then examines the teeth by pushing back the lips or opening the jaws with a soft gag.

The weigher now places the fox's tail in the loop of a broad strap attached to a spring balance and the head of the fox is then carefully lowered so that the animal hangs to the scale by its tail. The fox must not be dropped into a hanging position, as the sudden snap might injure the bone or cartilage of the tail. The weight is then called out and the agent makes note of it; he then notifies the weigher whether the fox is to be killed or released. If to be released, the animal is marked and dropped through the door "I" and makes its escape through the exit "K." If to be killed, it is passed to another man (the fox is still held by the tail) who strikes it a smart blow on the head with a light club. After the fox has been stunned in this manner, its neck is broken by manipulation. The Skinner waits a few moments to make certain that the animal is dead, after which he removes the pelt while the body is yet warm.

Handling of Skins.

Skinning.—Fox skins are removed much in the same manner as those of most fur-bearing animals that are prepared for the market. The tail is split for a few inches on the lower side, the cut beginning at the anus; cuts are then made along the inner side of each hind leg, these incisions extending from the heel (the lower end of the metatarsal bones) to the anus. The pelt is first loosened around the base of the tail, the tail is then pulled from its sheath of skin, and the entire pelt is removed by pushing it loose from the fat and flesh with the fingers, a knife being used only about the head. After the skin has been loosened from the posterior part of the body it is simply everted over the head, so that the nose is the last part to be severed. The forelegs are pulled out of the skin without any cutting, except where a knife may be needed to separate the pelt from the tougher subcutaneous tissues.

While the skin is being drawn off there is some danger of tearing it or of forcing a finger through it, but such holes are usually the result of haste or carelessness. However, tears are sometimes made by the best of skimmers, and in a large catch it may be difficult to secure perfect work throughout. Naturally, the pressure is always toward better workmanship.

After the skin has been entirely removed by the method outlined above, it is turned right side out and hung up on a peg or nail. When the work of the evening is over, the skins are counted, but are left in the trap building until ready for cleaning and stretching; the skins must be kept as cool as possible during this time.

During the first few killings of the season it is advisable to examine the flesh side of the skins, as the color found there is a good guide to the degree of primeness of the furs as a whole. The earliest skins may be found to be rather dark on the flesh side because of the roots of the growing hair and fur. This color fades as the season advances. While the writer has seen skins having what appeared to be fully prime pelage with the flesh side quite dark, it is not advisable to take any large number of skins during that part of the season when the bluish color on the flesh side of the skin is most pronounced.

The flesh side again darkens with the approach of unprimeness, but it has been observed on St. George Island that felted patches and rubbed spots are the first indication of the change. The fact that decision must be made before the fox is killed makes this a valuable point.

Cleaning.—The morning after the trapping the skins are taken to another building where the cleaning, stretching, and drying is done. The more skillful men sit in a row behind a beam which is placed in a horizontal position about 2 feet above the floor. A nail or peg is fixed in the beam opposite each man. The skin is turned flesh side out, the nose is placed over the peg and all the fat and flesh is removed with a very sharp skinning knife having a curved blade about 6 inches in length. The tail is split and all the fatty tissue removed from it; the forelegs can be cleaned without splitting. The work described here requires genuine skill with the knife.

After the pelt has been thus cleaned it is taken by one of the other workmen who turns the skin, rubs dry corn meal through the fur for the purpose of removing free grease or dampness, and then shakes it out. It is now turned again and searched for holes and if any are found they are sewed up. Small sticks are then inserted within the skin of the forelegs and bound in place; the tail is spread and bound round a larger stick and the skin is then ready for the stretching frame.

Stretching.—The stretching frame is a very simple arrangement of two light boards (1-inch material is usually used) put together on an acute angle, the length of the sides being in the neighborhood of 4 feet. The boards are joined edgewise, the nails of the joint being carefully toed; no third piece enters into the construction. After the joint has been secured, the boards are planed so that the edges form a smooth wedge with a rounded point. Properly made frames will last many years.

The skin is drawn on by inserting the smaller end of the frame in the opening across the hind legs and then slowly forcing it down the frame until the nose fits snugly. The entire surface of the pelt is then gently stretched downward with the palms of the workman's hands, and when it is well in place the hind legs are spread and bound to the sides of the frame in the manner shown in figure 3. The lips have been previously stitched together to prevent distortion of that part of the skin, and after the whole pelt has been well rubbed with corn meal it is set up for drying.

Drying.—The drying may be done in any large room where an even temperature can be maintained. It is always desirable to dry the skins slowly and with as little artificial heat as possible. The present method is to lay the frames in rows across light racks suspended from the ceiling at suitable intervals, the remainder of the frames being stood up about the walls. With the improvement of facilities this practice may be bettered.

After a lapse of from four to six days on the stretching frames the skins may be examined, and if dry all over, may be removed. The nose is one of the last parts of the skin to become fully dry. The skin should also be examined for excessive grease, and if any is found it must be removed with corn meal, for if it is left it will putrefy and weaken the skin. In taking the skin from the frame the hind and fore legs and tail are unbound and the skin gently started with the palms of the hands, after which it may be pulled off by the nose. When the skin has been removed from the frame a tag, bearing the date of capture, is tied into the mouth or eyeholes and the skin is hung up in the drying room for a few days, or until a sufficient number of pelts has accumulated for removal to the storage room.

Storing.—The two most important requirements for a storage room are dryness and darkness. The necessity for keeping the skins dry is apparent; the darkness is a safeguard against the fading of the fur, as the darkest furs command the highest prices. In storing the skins they are usually tied through the nose into clusters of 10 skins each, and these bunches are carefully tallied when stored. All the skins are again counted at the close of the season so as to verify the record of animals killed.

Shipping.—Fox skins are packed and shipped in boxes made of 1-inch boards of spruce or Douglas fir (spruce is preferable), with inside dimensions of 58 inches in length, 16 inches in width, and 12 inches in depth. The case is provided with a set of battens near each end, which lend rigidity to the whole and at the same time prevent any face of the box from coming into solid contact with a flat surface.

The packing of the skins is usually done within a day or two of the time shipment is to be made. The cases are lined with tarred building paper and relined with wrapping or newspaper as a protection against insects and dampness. The skins are carefully counted and laid flat in the case; unnecessary folding or creasing is to be avoided. The skins are shipped pelt side out. From 40 to 45 skins may be packed in a case such as the one described above.

After the proper number of skins has been packed in the box, the top is closed with the layers of paper and then the cover. The cover is nailed to the sides and ends of the case and to the battens on the sides. All cracks and holes are then closed by tacking on strips of galvanized iron or sheet zinc. The cases should be marked on both sides with the name and address of the consignee, the serial number and gross weight of the case, the number of skins it contains, and the legends, "Keep Away From Boiler Bulkheads" and "Keep Dry."

Disposition of Carcasses.

The disposition of fox carcasses is a matter of some importance. It is well known that foxes are, as a general rule, infested with parasites and intestinal worms of various kinds, and it should always be the effort of the agent to see that the carcasses of foxes killed are disposed of in such a manner as to prevent any possibility of infection from that source. The bodies of foxes found dead should be handled in a similar manner when practicable. The method now in use is that of putting the bodies into a covered pit a practice both simple and effective.

Breeding Reserve.

Selection of animals.—The breeding foxes must be selected with care. The points of judgment are: (1) The condition of the teeth; (2) depth of color and condition of fur, short fur or white patches indicating an undesirable animal; and (3) weight, reserved males to weigh not less than 11 pounds and females not less than 8½ pounds. Cripples are always killed, though a short-tailed fox may be released if the animal appears to be a particularly desirable one from other points of judgment.

Since the beginning of the present method of handling foxes on St. George Island it has been constantly the purpose to eliminate the white foxes. That it has been partially successful is shown by the presence of only 4 white

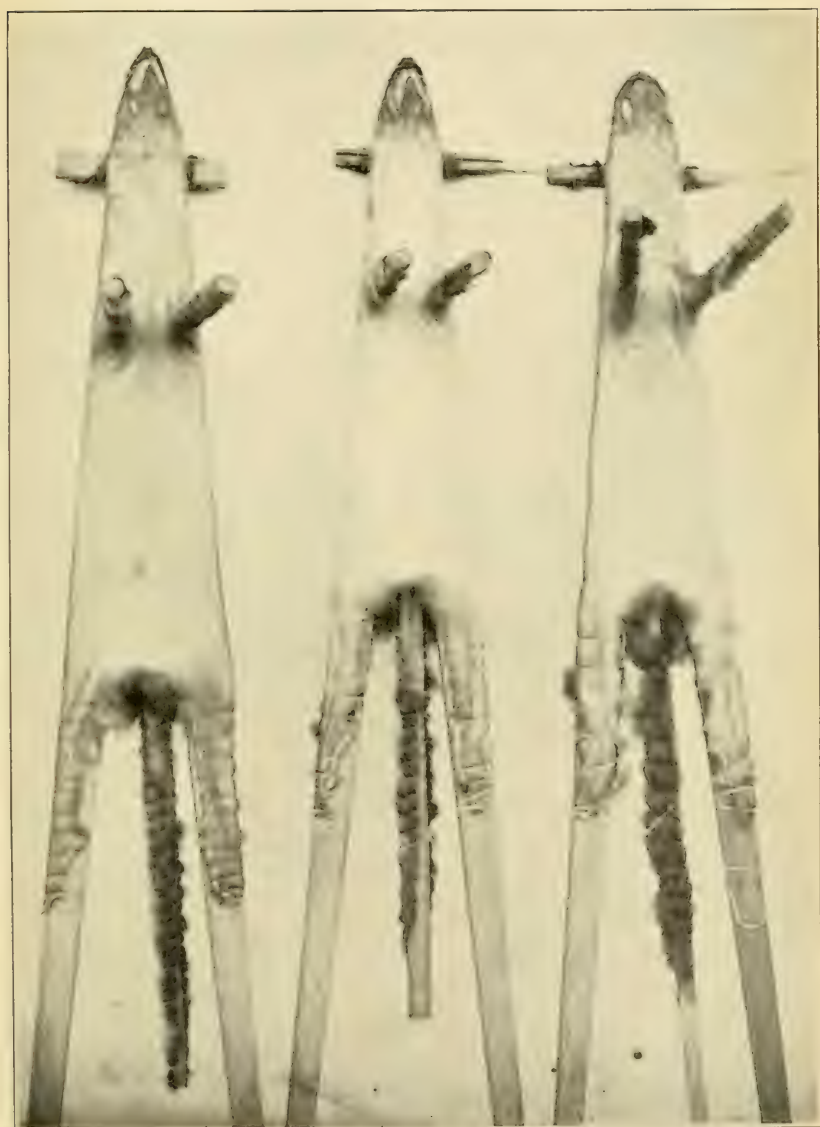


FIG. 2.—NATIVE METHOD OF STRETCHING AND DRYING BLUE FOX SKINS,
PRIBILOF ISLANDS, ALASKA.

skins in a catch of 750 taken during the season of 1919-20, as against 15 white pelts in a total of 486 secured in the season 1903-4. On St. Paul Island, where steel traps are being used and the selective killing is not carried on, 33 white animals appeared in a catch of 188 during the winter of 1919-20. The fight against white foxes on St. George Island has in recent years been extended against blue foxes which bear white marks of any kind.

After the selection of the breeder it is marked by clipping the fur of the tail and is then released. This mark is a notch near the tip of the tail in the case of a male and near the middle of the tail for a female. No such marked foxes are killed intentionally, and to avoid the possibility of such error it is a good plan to make the mark sufficiently plain to preclude any chance that the weigher may not notice it. Light marks made early in the season may grow to be almost indistinguishable before trapping stops.

The blue fox of St. George Island is monogamous, and because of this fact the sexes must be released in equal numbers when the reserve is made.

Size of reserve.—The amount of food available during the winter months is the factor which controls the size to which the herd may be allowed to grow. The release of 200 pairs of breeding animals for a number of years past has provided a steady supply of skins, but this number must be gradually increased in proportion to the food supply if a sound policy of growth is to be carried out. During the season of 1919-20 a reserve of 225 pairs was made with a view to such a growth, and it is intended that the reserve be further increased each season that the food situation will allow.

A consideration of the reserve naturally must bring in the factors of the number of young which reach maturity for each pair released and the percentage of natural mortality for all classes of foxes. It is to be deplored that we know little of these factors, except as light has been thrown upon them by the growth or decline of the herd. From the past rate of growth we may assume a given number of maturing young and a given death rate, both of which are subject to an unknown correction of animals not caught, but such figures are somewhat arbitrary and must be used with caution. We can not place dependence on the uncertain figure of the number of maturing young or the unknown reserve of animals not handled; the only reliable figures are those from known reserves, and it is upon these we must base our policy.

REINDEER.

In August of 1911, 40 reindeer were brought to the Pribilof Islands to determine whether these animals would thrive and eventually provide a source of fresh meat for the Government employees and natives stationed there. Twenty-one cows and 4 bulls were landed on St. Paul Island and 12 cows and 3 bulls on St. George Island.

The experiment has proved entirely successful. While the herds have become quite wild and difficult to handle through lack of time for attending them, fairly accurate counts at the close of the calendar year 1920 showed 192 deer on St. Paul Island and 125 on St. George Island. The herds are becoming regularly more valuable as a meat supply, the number used for this purpose being larger each year. On St. Paul Island 22 reindeer were killed for food during the calendar year 1920 and on St. George Island 31 were so used. In the previous year 14 on St. Paul and 22 on St. George were killed for food.

SHIPMENTS OF FUR-SEAL AND FOX SKINS FROM PRIBILOF ISLANDS IN 1920.

Fur-seal skins.—Three shipments of sealskins were made from the Pribilof Islands in the calendar year 1920. The first of these was made up of 900 skins in 47 casks from St. Paul Island and 412 skins in 14 casks from St. George Island, the number from the latter place being the entire remainder of the catch of 1919 on that island. The

shipment left the islands April 7 on the Bureau's tender *Eider*, was transferred to the Alaska Steamship Co.'s steamship *Victoria* at Unalaska on April 19 for shipment to Seattle, Wash., and left the latter place on April 27 for St. Louis by freight via Northern Pacific to Minnesota Transfer and Chicago, Burlington & Quincy, arriving at St. Louis May 20.

On June 22 the U. S. S. *Saturn* took the remainder of the 1919 skins from St. Paul Island; the shipment was made up of 37 casks containing 505 skins. The *Saturn* proceeded to Bremerton, Wash., from which place the skins were forwarded July 7 to St. Louis by the same route as the first shipment. They arrived at St. Louis July 26.

The third shipment consisted of 476 casks containing 21,929 skins from St. Paul Island and 24 casks containing 1,133 skins from St. George Island; all were skins of the 1920 take. The skins were placed on board the *Saturn* November 25 for transportation to Seattle, Wash., left that place December 6, and arrived at St. Louis December 15, having been shipped by freight via Northern Pacific to Billings, and Chicago, Burlington & Quincy to St. Louis. This shipment made remarkably good time between Seattle and St. Louis, arriving in a little less than nine days.

Thirteen specimen skins were also shipped during the year. Four of these were from St. George Island and nine from St. Paul Island. The skins were brought south on the *Saturn*, arrived at Seattle September 26, and were shipped from there by express to the American Museum of Natural History at New York City.

Fox skins.—A single shipment of fox skins was made during 1920. This shipment consisted of 4 cases containing 155 blue and 33 white fox skins from St. Paul Island and 18 cases containing 746 blue and 4 white skins from St. George Island, a total of 938 skins. These cases were shipped in the same manner as the first shipment of seal-skins as far as Seattle, via the Bureau's vessel *Eider* and the commercial steamer *Victoria*, and from Seattle to St. Louis by express, where they arrived May 3.

SALES OF FUR-SEAL SKINS.

Two sales of dressed, dyed, and machined fur-seal skins from the Pribilof Islands were held in St. Louis during the calendar year 1920. One was on February 2 and the other May 10, at which times 9,100 and 5,752 skins were sold at auction for totals of \$1,282,905 and \$424,166, respectively.

The highest price secured at the February sale was for a lot of 70 skins, which brought \$177 each; the average price obtained was \$140.97, an increase of nearly 55 per cent over the average price at the preceding sale in September, 1919. At the sale in May the maximum price was \$125 per skin on two lots of wigs, 50 skins in each lot. The average price for the May sale was \$73.74, showing a decrease of about 48 per cent as compared with the February sale.

The first two of the following tables show details regarding the prices secured for each lot of skins in the two sales; the third table is a summary showing prices obtained for the skins in the various trade classes, with the percentages which the number of the skins in these several classes bore to the totals in each sale.

SALES OF DRESSED, DYED, AND MACHINED PRIBILOF FUR-SEAL SKINS AT ST. LOUIS, 1920.

SALE OF 9,100 SKINS, ST. LOUIS, FEB. 2, 1920.

| Lot No. | Number of skins. | Trade classification. | Price per skin. | Total for lot. | Lot No. | Number of skins. | Trade classification. | Price per skin. | Total for lot. |
|---------|------------------|---|-----------------|----------------|---------|------------------|--|-----------------|----------------|
| 1 | 50 | Wigs..... | \$152.00 | \$7,600.00 | 73 | 70 | Extra large; cut, scarred, etc..... | \$127.00 | \$8,890.00 |
| 2 | 50 | do..... | 157.00 | 7,850.00 | 74 | 70 | do..... | 129.00 | 9,030.00 |
| 3 | 50 | do..... | 155.00 | 7,750.00 | 75 | 70 | do..... | 130.00 | 9,100.00 |
| 4 | 50 | do..... | 157.00 | 7,850.00 | 76 | 80 | Large..... | 160.00 | 12,800.00 |
| 5 | 50 | do..... | 156.00 | 7,800.00 | 77 | 80 | do..... | 157.00 | 12,560.00 |
| 6 | 50 | do..... | 156.00 | 7,800.00 | 78 | 80 | do..... | 164.00 | 13,120.00 |
| 7 | 50 | do..... | 156.00 | 7,800.00 | 79 | 80 | do..... | 162.00 | 12,960.00 |
| 8 | 50 | do..... | 156.00 | 7,800.00 | 80 | 80 | do..... | 162.00 | 12,960.00 |
| 9 | 50 | do..... | 162.00 | 8,100.00 | 81 | 80 | do..... | 161.00 | 12,880.00 |
| 10 | 50 | do..... | 162.00 | 8,100.00 | 82 | 80 | do..... | 161.00 | 12,880.00 |
| 11 | 50 | do..... | 163.00 | 8,150.00 | 83 | 80 | do..... | 160.00 | 12,800.00 |
| 12 | 50 | do..... | 167.00 | 8,350.00 | 84 | 80 | do..... | 159.00 | 12,720.00 |
| 13 | 50 | do..... | 169.00 | 8,450.00 | 85 | 80 | do..... | 160.00 | 12,800.00 |
| 14 | 50 | do..... | 168.00 | 8,400.00 | 86 | 80 | do..... | 161.00 | 12,880.00 |
| 15 | 50 | do..... | 169.00 | 8,450.00 | 87 | 80 | do..... | 162.00 | 12,960.00 |
| 16 | 50 | Wigs; cut, scarred, etc..... | 115.00 | 5,750.00 | 88 | 80 | do..... | 162.00 | 12,960.00 |
| 17 | 50 | do..... | 116.00 | 5,800.00 | 89 | 80 | do..... | 161.00 | 12,880.00 |
| 18 | 50 | do..... | 115.00 | 5,750.00 | 90 | 80 | do..... | 160.00 | 12,800.00 |
| 19 | 50 | do..... | 117.00 | 5,850.00 | 91 | 80 | do..... | 161.00 | 12,880.00 |
| 20 | 50 | do..... | 120.00 | 6,000.00 | 92 | 80 | do..... | 160.00 | 12,800.00 |
| 21 | 50 | do..... | 118.00 | 5,900.00 | 93 | 80 | do..... | 163.00 | 13,040.00 |
| 22 | 60 | Extra extra large..... | 167.00 | 10,020.00 | 94 | 80 | do..... | 165.00 | 13,200.00 |
| 23 | 60 | do..... | 171.00 | 10,260.00 | 95 | 50 | Large; cut, scarred, etc..... | 116.00 | 9,280.00 |
| 24 | 60 | do..... | 167.00 | 10,020.00 | 96 | 80 | do..... | 118.00 | 9,440.00 |
| 25 | 60 | do..... | 166.00 | 9,960.00 | 97 | 80 | do..... | 116.00 | 9,280.00 |
| 26 | 60 | do..... | 166.00 | 9,960.00 | 98 | 80 | do..... | 116.00 | 9,280.00 |
| 27 | 60 | do..... | 171.00 | 10,260.00 | 99 | 80 | do..... | 125.00 | 10,000.00 |
| 28 | 60 | do..... | 172.00 | 10,320.00 | 100 | 80 | do..... | 115.00 | 9,200.00 |
| 29 | 60 | do..... | 170.00 | 10,200.00 | 101 | 80 | do..... | 116.00 | 9,280.00 |
| 30 | 60 | do..... | 170.00 | 10,200.00 | 102 | 80 | do..... | 119.00 | 9,520.00 |
| 31 | 60 | do..... | 171.00 | 10,260.00 | 103 | 90 | Mediums..... | 124.00 | 11,160.00 |
| 32 | 60 | do..... | 168.00 | 10,080.00 | 104 | 90 | do..... | 126.00 | 11,340.00 |
| 33 | 60 | do..... | 167.00 | 10,020.00 | 105 | 90 | do..... | 123.00 | 11,070.00 |
| 34 | 60 | do..... | 174.00 | 10,440.00 | 106 | 90 | do..... | 123.00 | 11,070.00 |
| 35 | 60 | do..... | 170.00 | 10,200.00 | 107 | 90 | do..... | 122.00 | 10,980.00 |
| 36 | 60 | do..... | 173.00 | 10,380.00 | 108 | 90 | do..... | 121.00 | 10,890.00 |
| 37 | 60 | do..... | 171.00 | 10,260.00 | 109 | 90 | do..... | 121.00 | 10,890.00 |
| 38 | 60 | do..... | 169.00 | 10,140.00 | 110 | 90 | do..... | 122.00 | 10,980.00 |
| 39 | 60 | do..... | 168.00 | 10,080.00 | 111 | 90 | do..... | 121.00 | 10,890.00 |
| 40 | 60 | do..... | 172.00 | 10,320.00 | 112 | 90 | do..... | 121.00 | 10,890.00 |
| 41 | 60 | do..... | 172.00 | 10,320.00 | 113 | 90 | do..... | 121.50 | 10,935.00 |
| 42 | 60 | do..... | 172.00 | 10,320.00 | 114 | 90 | do..... | 120.00 | 10,800.00 |
| 43 | 60 | do..... | 171.00 | 10,260.00 | 115 | 90 | do..... | 123.00 | 11,070.00 |
| 44 | 60 | do..... | 171.00 | 10,260.00 | 116 | 90 | do..... | 122.00 | 10,980.00 |
| 45 | 60 | Extra extra large; cut, scarred, etc..... | 124.00 | 7,440.00 | 117 | 90 | do..... | 123.00 | 11,070.00 |
| 46 | 60 | do..... | 124.00 | 7,440.00 | 118 | 90 | do..... | 122.00 | 10,980.00 |
| 47 | 60 | do..... | 131.00 | 7,860.00 | 119 | 90 | Mediums; cut, scarred, etc..... | 100.00 | 9,000.00 |
| 48 | 60 | do..... | 127.00 | 7,620.00 | 120 | 90 | do..... | 99.00 | 8,910.00 |
| 49 | 60 | do..... | 130.00 | 7,800.00 | 121 | 90 | do..... | 102.50 | 9,225.00 |
| 50 | 60 | do..... | 127.00 | 7,620.00 | 122 | 90 | do..... | 104.00 | 9,360.00 |
| 51 | 60 | do..... | 131.00 | 7,860.00 | 123 | 90 | do..... | 105.00 | 9,450.00 |
| 52 | 60 | do..... | 139.00 | 7,800.00 | 124 | 90 | Small mediums..... | 90.00 | 8,100.00 |
| 53 | 60 | do..... | 131.00 | 7,860.00 | 125 | 60 | do..... | 90.00 | 5,400.00 |
| 54 | 60 | do..... | 132.00 | 7,920.00 | 126 | 90 | Small mediums; cut, scarred, etc..... | 70.00 | 6,300.00 |
| 55 | 70 | Extra large..... | 161.00 | 11,270.00 | 127 | 50 | III wigs..... | 71.00 | 3,550.00 |
| 56 | 70 | do..... | 169.00 | 11,830.00 | 128 | 50 | do..... | 71.00 | 3,550.00 |
| 57 | 70 | do..... | 173.00 | 12,110.00 | 129 | 60 | III extra extra large..... | 82.00 | 4,920.00 |
| 58 | 70 | do..... | 172.00 | 12,040.00 | 130 | 70 | III-25 extra large, 45 large..... | 64.00 | 4,480.00 |
| 59 | 70 | do..... | 170.00 | 11,900.00 | 131 | 60 | III-50 mediums, 10 small mediums..... | 57.00 | 3,420.00 |
| 60 | 70 | do..... | 174.00 | 12,180.00 | 132 | 20 | IV-9 wigs, 3 extra extra large, 2 extra large, 2 large, 4 mediums..... | 56.00 | 1,120.00 |
| 61 | 70 | do..... | 171.00 | 11,970.00 | | | | | |
| 62 | 70 | do..... | 173.00 | 12,110.00 | | | | | |
| 63 | 70 | do..... | 168.00 | 11,760.00 | | | | | |
| 64 | 70 | do..... | 169.00 | 11,830.00 | | | | | |
| 65 | 70 | do..... | 170.00 | 11,900.00 | | | | | |
| 66 | 70 | do..... | 168.00 | 11,760.00 | | | | | |
| 67 | 70 | do..... | 168.00 | 11,760.00 | | | | | |
| 68 | 70 | do..... | 168.50 | 11,795.00 | | | | | |
| 69 | 70 | do..... | 177.00 | 12,390.00 | | | | | |
| 70 | 70 | Extra large; cut, scarred, etc..... | 134.00 | 9,380.00 | | | | | |
| 71 | 70 | do..... | 130.00 | 9,100.00 | | | | | |
| 72 | 70 | do..... | 128.00 | 8,960.00 | | | | | |

SALES OF DRESSED, DYED, AND MACHINED PRIBILOF FUR-SEAL SKINS AT ST. LOUIS, 1920—Continued.

SALE OF 5,752 SKINS, ST. LOUIS, MAY 10, 1920.

| Lot No. | Number of skins. | Trade classification. | Price per skin. | Total for lot. | Lot No. | Number of skins. | Trade classification. | Price per skin. | Total for lot. |
|---------|------------------|-------------------------------------|-----------------|----------------|---------|------------------|---|-----------------|----------------|
| 1 | 50 | Wigs | \$125.00 | \$6,250.00 | 49 | 80 | Large | \$81.00 | \$6,480.00 |
| 2 | 50 | do | 125.00 | 6,250.00 | 50 | 80 | do | 81.00 | 6,480.00 |
| 3 | 50 | do | 123.00 | 6,150.00 | 51 | 80 | do | 81.00 | 6,480.00 |
| 4 | 50 | do | 123.00 | 6,150.00 | 52 | 80 | do | 80.00 | 6,400.00 |
| 5 | 50 | do | 122.00 | 6,100.00 | 53 | 40 | do | 81.00 | 3,240.00 |
| 6 | 50 | Wigs; cut, scarred, etc. | 79.00 | 3,950.00 | 54 | 80 | Large; cut, scarred, etc. | 57.00 | 4,560.00 |
| 7 | 50 | do | 72.00 | 3,600.00 | 55 | 80 | do | 52.00 | 4,160.00 |
| 8 | 50 | do | 78.00 | 3,900.00 | 56 | 80 | do | 50.00 | 4,000.00 |
| 9 | 50 | do | 79.00 | 3,950.00 | 57 | 80 | do | 50.00 | 4,000.00 |
| 10 | 60 | Extraextralarge | 124.00 | 7,440.00 | 58 | 80 | do | 49.00 | 3,920.00 |
| 11 | 60 | do | 121.00 | 7,260.00 | 59 | 70 | do | 49.00 | 3,430.00 |
| 12 | 60 | do | 120.00 | 7,200.00 | 60 | 90 | Mediums | 71.00 | 6,390.00 |
| 13 | 60 | do | 117.00 | 7,020.00 | 61 | 90 | do | 68.00 | 6,120.00 |
| 14 | 60 | do | 113.00 | 6,780.00 | 62 | 90 | do | 65.00 | 5,850.00 |
| 15 | 60 | do | 114.00 | 6,840.00 | 63 | 90 | do | 66.00 | 5,940.00 |
| 16 | 60 | do | 112.00 | 6,720.00 | 64 | 90 | do | 63.00 | 5,670.00 |
| 17 | 60 | do | 112.00 | 6,720.00 | 65 | 90 | do | 65.00 | 5,850.00 |
| 18 | 60 | do | 111.00 | 6,660.00 | 66 | 90 | do | 64.00 | 5,760.00 |
| 19 | 60 | do | 115.00 | 6,900.00 | 67 | 90 | do | 66.00 | 5,940.00 |
| 20 | 60 | Extraextralarge; cut, scarred, etc. | 90.00 | 5,400.00 | 68 | 90 | Mediums; cut, scarred, etc. | 50.00 | 4,500.00 |
| 21 | 60 | do | 79.00 | 4,740.00 | 69 | 90 | do | 45.00 | 4,050.00 |
| 22 | 60 | do | 72.00 | 4,320.00 | 70 | 90 | do | 44.00 | 3,960.00 |
| 23 | 60 | do | 67.00 | 4,020.00 | 71 | 90 | do | 44.00 | 3,960.00 |
| 24 | 60 | do | 64.00 | 3,840.00 | 72 | 90 | do | 46.00 | 4,140.00 |
| 25 | 60 | do | 64.00 | 3,840.00 | 73 | 90 | Small mediums | 55.00 | 4,950.00 |
| 26 | 30 | do | 64.00 | 1,920.00 | 74 | 70 | Small mediums; scarred, etc. | 39.00 | 2,730.00 |
| 27 | 70 | Extra large | 108.00 | 7,560.00 | 75 | 50 | III Wigs | 40.00 | 2,000.00 |
| 28 | 70 | do | 98.00 | 6,860.00 | 76 | 50 | do | 41.00 | 2,050.00 |
| 29 | 70 | do | 93.00 | 6,510.00 | 77 | 50 | do | 41.00 | 2,050.00 |
| 30 | 70 | do | 92.00 | 6,440.00 | 78 | 50 | III Extra extra large | 37.00 | 1,850.00 |
| 31 | 70 | do | 92.00 | 6,440.00 | 79 | 60 | III Extra large | 37.00 | 2,220.00 |
| 32 | 70 | do | 91.00 | 6,370.00 | 80 | 60 | III Large | 36.00 | 2,160.00 |
| 33 | 70 | do | 91.00 | 6,370.00 | 81 | 70 | III Mediums | 25.00 | 1,820.00 |
| 34 | 70 | do | 93.00 | 6,510.00 | 82 | 30 | III Small mediums | 19.00 | 570.00 |
| 35 | 70 | do | 93.00 | 6,510.00 | 83 | 50 | IV Wigs | 10.00 | 500.00 |
| 36 | 70 | Extra large; cut, scarred, etc. | 65.00 | 4,550.00 | 84 | 50 | IV—3 extra extra large, 19 extra large, 10 large, 10 mediums, 8 small mediums | 21.00 | 1,050.00 |
| 37 | 70 | do | 60.00 | 4,200.00 | 87 | 12 | Skins—4 extra large, 4 large, 3 mediums, 1 small medium | 53.00 | 636.00 |
| 38 | 70 | do | 60.00 | 4,200.00 | | | | | |
| 39 | 70 | do | 59.00 | 4,130.00 | | | | | |
| 40 | 70 | do | 59.00 | 4,130.00 | | | | | |
| 41 | 80 | Large | 92.00 | 7,360.00 | | | | | |
| 42 | 80 | do | 86.00 | 6,880.00 | | | | | |
| 43 | 80 | do | 84.00 | 6,720.00 | | | | | |
| 44 | 80 | do | 83.00 | 6,640.00 | | | | | |
| 45 | 80 | do | 81.00 | 6,480.00 | | | | | |
| 46 | 80 | do | 82.00 | 6,560.00 | | | | | |
| 47 | 80 | do | 81.00 | 6,480.00 | | | | | |
| 48 | 80 | do | 81.00 | 6,480.00 | | | | | |
| | | | | | | 5,752 | | | 424,166.00 |

COMPARATIVE VALUES BY GRADES AND SIZES, WITH PERCENTAGES EACH SIZE OF SEALSKINS SOLD IN 1920.

| Classes and sales. | Grade. | Number. | High. | Low. | Average. | Total. | Total number. | Average. | Total price. | Percentage. |
|--------------------|-------------|---------|----------|----------|----------|--------------|---------------|----------|--------------|-------------|
| Wigs: | | | | | | | | | | |
| Feb. 2... | I and II... | 750 | \$169.00 | \$152.00 | \$160.20 | \$120,150.00 | 1,159 | \$140.47 | \$162,804.00 | 12.74 |
| | Cut, etc. | 300 | 120.00 | 115.00 | 116.83 | 35,050.00 | | | | |
| | III | 100 | 71.00 | 71.00 | 71.00 | 7,100.00 | | | | |
| | IV | 9 | 56.00 | 56.00 | 56.00 | 504.00 | | | | |
| May 10... | I and II... | 250 | 125.00 | 122.00 | 123.60 | 30,900.00 | 650 | 81.38 | 52,900.00 | 11.31 |
| | Cut, etc. | 200 | 79.00 | 72.00 | 77.00 | 15,400.00 | | | | |
| | III | 150 | 41.00 | 40.00 | 40.66 | 6,100.00 | | | | |
| | IV | 50 | 10.00 | 10.00 | 10.00 | 500.00 | | | | |

COMPARATIVE VALUES BY GRADES AND SIZES, WITH PERCENTAGES EACH SIZE OF SEALSKINS SOLD IN 1920—Continued.

| Classes and sales. | Grade. | Number. | High. | Low. | Average. | Total. | Total number. | Average. | Total price. | Percentage. |
|--------------------|-------------|---------|----------|----------|----------|--------------|---------------|----------|--------------|-------------|
| Extra extra large: | | | | | | | | | | |
| Feb. 2... | I and II... | 1,380 | \$174.00 | \$166.66 | \$169.91 | \$234,480.00 | 2,043 | \$155.06 | \$316,788.00 | 22.45 |
| | Cut, etc... | 600 | 132.00 | 124.00 | 128.70 | 77,220.00 | | | | |
| | III... | 60 | 82.00 | 82.00 | 82.00 | 4,920.00 | | | | |
| | IV... | 3 | 56.00 | 56.00 | 56.00 | 168.00 | | | | |
| May 10... | I and II... | 660 | 124.00 | 111.00 | 115.90 | 69,540.00 | 1,943 | 95.43 | 99,533.00 | 18.14 |
| | Cut, etc... | 390 | 90.00 | 64.00 | 72.00 | 28,080.00 | | | | |
| | III... | 50 | 37.00 | 37.00 | 37.00 | 1,850.00 | | | | |
| | IV... | 3 | 21.00 | 21.00 | 21.00 | 63.00 | | | | |
| Extra large: | | | | | | | | | | |
| Feb. 2... | I and II... | 1,050 | 177.00 | 161.00 | 170.10 | 178,605.00 | 1,497 | 156.83 | 241,777.00 | 16.45 |
| | Cut, etc... | 420 | 134.00 | 127.00 | 129.67 | 54,460.00 | | | | |
| | III... | 25 | 61.00 | 61.00 | 61.00 | 1,600.00 | | | | |
| | IV... | 2 | 56.00 | 56.00 | 56.00 | 112.00 | | | | |
| May 10... | I and II... | 630 | 108.00 | 91.00 | 94.55 | 59,570.00 | 1,963 | 78.66 | 83,611.00 | 18.48 |
| | Cut, etc... | 350 | 65.00 | 59.00 | 60.60 | 21,210.00 | | | | |
| | III... | 60 | 37.00 | 37.00 | 37.00 | 2,230.00 | | | | |
| | IV... | 19 | 21.00 | 21.00 | 21.00 | 399.00 | | | | |
| Large: | Oddskins... | 4 | 53.00 | 53.00 | 53.00 | 212.00 | | | | |
| | I and II... | 1,520 | 165.00 | 157.00 | 161.11 | 244,880.00 | 2,207 | 146.42 | 323,152.00 | 24.25 |
| | Cut, etc... | 610 | 125.00 | 115.00 | 117.63 | 75,280.00 | | | | |
| | III... | 45 | 64.00 | 64.00 | 64.00 | 2,880.00 | | | | |
| | IV... | 2 | 56.00 | 56.00 | 56.00 | 112.00 | | | | |
| May 10... | I and II... | 1,074 | 92.00 | 80.00 | 82.71 | 82,680.00 | 1,514 | 70.80 | 109,332.00 | 26.85 |
| | Cut, etc... | 450 | 57.00 | 49.00 | 51.21 | 24,070.00 | | | | |
| | III... | 60 | 36.00 | 36.00 | 36.00 | 2,160.00 | | | | |
| | IV... | 10 | 21.00 | 21.00 | 21.00 | 210.00 | | | | |
| Mediums: | Oddskins... | 4 | 53.00 | 53.00 | 53.00 | 212.00 | | | | |
| | I and II... | 1,440 | 126.00 | 121.00 | 122.22 | 175,995.00 | 1,964 | 115.75 | 225,914.00 | 21.36 |
| | Cut, etc... | 450 | 105.00 | 99.00 | 102.35 | 45,945.00 | | | | |
| | III... | 30 | 57.00 | 57.00 | 57.00 | 2,850.00 | | | | |
| | IV... | 4 | 56.00 | 56.00 | 56.00 | 224.00 | | | | |
| May 10... | I and II... | 720 | 71.00 | 63.00 | 66.00 | 47,520.00 | 1,233 | 56.12 | 70,319.00 | 21.77 |
| | Cut, etc... | 450 | 66.00 | 44.00 | 45.80 | 20,610.00 | | | | |
| | III... | 70 | 26.00 | 26.00 | 26.00 | 1,820.00 | | | | |
| | IV... | 10 | 21.00 | 21.00 | 21.00 | 210.00 | | | | |
| Small mediums: | Oddskins... | 3 | 53.00 | 53.00 | 53.00 | 159.00 | | | | |
| | I and II... | 150 | 90.00 | 90.00 | 90.00 | 13,500.00 | 250 | 81.48 | 20,370.00 | 2.75 |
| | Cut, etc... | 90 | 70.00 | 70.00 | 70.00 | 6,300.00 | | | | |
| | III... | 16 | 57.00 | 57.00 | 57.00 | 912.00 | | | | |
| | IV... | 4 | 56.00 | 56.00 | 56.00 | 224.00 | | | | |
| May 10... | I and II... | 90 | 55.00 | 55.00 | 55.00 | 4,950.00 | 199 | 42.57 | 8,471.00 | 3.45 |
| | Cut, etc... | 70 | 39.00 | 39.00 | 39.00 | 2,730.00 | | | | |
| | III... | 30 | 19.00 | 19.00 | 19.00 | 570.00 | | | | |
| | IV... | 8 | 21.00 | 21.00 | 21.00 | 168.00 | | | | |
| Both sales | Oddskins... | 1 | 53.00 | 53.00 | 53.00 | 53.00 | | | | |
| | | | | | | | 9,100 | 140.97 | 1,282,905.00 | 100.00 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Both sales | | | | | | | 5,752 | 73.74 | 424,166.00 | 100.00 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Both sales | | | | | | | 14,852 | 114.91 | 1,707,071.00 | 100.00 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

SUMMARY OF FUR-SEAL SKINS SHIPPED TO FUNSTEN BROS. & CO.

The table published in the report on the Alaska Fisheries and Fur Industries in 1919, stated that at the end of the calendar year 1919 there were on hand at St. Louis in all 47,615 fur-seal skins from the Pribilof Islands. Of these 43 were so-called food skins, taken during the close season ended August 24, 1917, and the remaining 47,572 were commercial skins taken after that date. A letter of February 17, 1921, from Funsten Bros. & Co., the Bureau's selling agents, stated that in unpacking the shipment received in November, 1919, one more skin was found than was reported shipped. This made the grand

total on hand January 1, 1920, 47,616 skins. The following table shows shipments received and sales of skins by the firm during the calendar year 1920:

SUMMARY OF PRIBILOF ISLANDS FUR-SEAL SKINS RECEIVED AND SOLD BY FUNSTEN BROS. & Co., ST. LOUIS, MO., AND BALANCES IN FIRM'S CUSTODY, CALENDAR YEAR 1920.

| Receipts. | | | Sales. | | | | Balances on hand. | | |
|----------------------------------|--------------------------|------------------|---------------|--------------------------|-------------------------------------|--------|--------------------------|-------------------------------------|--------|
| Date of shipment from Pribilofs. | Date of receipt by firm. | Number of skins. | Date of sale. | Number of skins. | | Total. | Food skins. ¹ | Commer- cial skins. ² | Total. |
| | | | | Food skins. ¹ | Commer- cial skins. ² | | | | |
| | | | Jan. 20..... | 31 | | 31 | 43 | 47,573 | 47,616 |
| | | | Feb. 2..... | | 9,100 | 9,100 | 12 | 47,573 | 47,585 |
| Apr. 6..... | May 20..... | 1,312 | | | | | 12 | 38,473 | 38,485 |
| | | | May 10..... | 12 | 5,740 | 5,752 | 12 | 39,785 | 39,797 |
| June 22..... | July 30..... | 505 | | | | | | 34,045 | 34,045 |
| Nov. 25..... | Dec. 15..... | 23,062 | | | | | | 34,550 | 34,550 |
| | | | | | | | | 57,612 | 57,612 |

¹ Skins taken from seals killed for natives' food prior to the termination on Aug. 24, 1917, of the 5-year period of restricted killings provided by the act of Aug. 24, 1912.

² Skins taken subsequent to Aug. 24, 1917.

FUR-SEAL SKINS ON HAND DECEMBER 31, 1920.

As in the published report for the preceding calendar year, a statement as to the number of fur-seal skins handled during the year and the number on hand, both at the Pribilof Islands and at St. Louis, at the end of the calendar year 1920 is submitted as follows:

ST. LOUIS RECORD OF SEALSKINS.

| | |
|---|---------|
| On hand Jan. 1, 1920..... | 147,616 |
| Shipments received in 1920: | |
| May..... | 1,312 |
| July..... | 505 |
| December..... | 23,062 |
| | 24,879 |
| Total..... | 72,495 |
| Sales during 1920: | |
| January ² | 31 |
| February..... | 9,100 |
| May..... | 5,752 |
| | 14,883 |
| Balance on hand at St. Louis Dec. 31, 1920..... | 57,612 |

PRIBILOF RECORD OF SEALSKINS.

| | |
|------------------------|-------|
| On hand Jan. 1, 1920: | |
| St. Paul Island..... | 1,405 |
| St. George Island..... | 412 |
| | 1,817 |

¹ The preceding report for 1919 gave the number on hand as 47,615, but when the shipment received November, 1919, was unpacked in 1920, one more skin was found than was reported shipped, thereby increasing the number on hand by 1.

² Funsten Bros. & Co. paid the Government at the rate of \$80 each for 31 sealskins, of which the firm reported 17 spoiled in work and 14 prepared for exhibition purposes.

| | | |
|--|--------|--------|
| Skins taken in 1920: | | |
| St. Paul Island | 22,220 | |
| St. George Island | 4,428 | |
| | | 26,648 |
| Total | | 28,465 |
| Shipments during 1920: | | |
| St. Paul Island | 23,334 | |
| St. George Island | 1,545 | |
| | | 24,879 |
| Balance on hand at Pribilofs Dec. 31, 1920 | | 3,586 |
| Grand total on hand Dec. 31, 1920 | | 61,198 |

SALE OF FOX SKINS POSTPONED.

The 901 blue and 37 white fox skins taken at the Pribilofs in the winter 1919-20 were not sold during the year 1920, the condition of the fur market making it advisable to defer their sale.

PATROL OF NORTH PACIFIC OCEAN AND BERING SEA.

As in previous years, a patrol was maintained by the Coast Guard for the protection of the migrating fur-seal herd and the prevention of poaching in the vicinity of the Pribilof Islands. Numerous courtesies in the way of transportation of passengers, mail, and freight for the Bureau are also gratefully acknowledged. The following extracts from a statement prepared by the Coast Guard relate in detail the work performed during the year:

MEMORANDUM CONCERNING OPERATIONS OF THE COAST GUARD IN CONNECTION WITH PATROLLING THE NORTH PACIFIC OCEAN AND BERING SEA DURING THE SEASON OF 1920.

The North Pacific Ocean and Bering Sea patrol, commanded by Commander J. H. Brown, United States Coast Guard, for the season of 1920 was made by the Coast Guard cutters *Unalga*, *Algonquin*, *Bear*, and *Bothwell*. These vessels were actively engaged during the season on patrol and in such additional work as furnishing transportation to various persons, including natives, civil authorities, school-teachers, and destitutes; delivering United States mail, food, and supplies to isolated settlements; assisting distressed vessels; extending succor to persons in need; furnishing medical treatment to natives; and enforcing the laws.

The *Unalga*, in command of Lieut. Commander B. L. Brockway, left Seattle on April 28, 1920, for Unalaska. The cutter had on board seven passengers for transportation to various points in Alaska, four of whom were employees of the Bureau of Fisheries. On May 7 she arrived at Unalaska, where all passengers left the vessel. The medical officer attached to the *Unalga* inspected the town of Unalaska and found the health and sanitary conditions to be good.

On May 14 the *Unalga* left Unalaska on her first cruise in Alaskan waters. She proceeded to Unimak Pass, cruised along the southern shore of Unimak Island, then visited Davidson Bank, and traveled along the fishing banks as far east as Sannak Islands. During this trip no fishing vessels were sighted.

On June 18 she left Unalaska for a cruise in the vicinity of Slime Bank. The only vessel seen on this trip was the American schooner *Wacona*, to which mail was delivered and to the crew of which medical treatment was afforded. The cutter later left for the Pribilof Islands and cruised in that vicinity for more than a week, but found no vessels in need of assistance. Two more trips were made to the Pribilof Islands and Slime Bank and to other fishing banks in Bristol Bay as far east as Ugashik River. While on one of these cruises the American schooner *City of Papeete* was boarded and medical treatment given to some members of her crew.

On August 14 the commanding officer of the *Unalga*, while serving in the capacity of United States commissioner, acted as arbitrator in a labor dispute at the Wood River cannery of the Alaska Salmon Co. Through his efforts a reconciliation was effected and the men returned to work. * * * On August 18 the *Unalga* cruised over the fishing grounds off Hagemeister Island, but sighted no fishing vessels while on this trip.

On October 20 Mr. A. H. Proctor, superintendent, Pribilof Islands, and several natives, were transported to the northeast point of St. Paul Island to obtain a quantity of salted sealskins, the motor boat of the Bureau of Fisheries being disabled at the time. * * * On November 23 the cutter proceeded to Sand Point, where the medical officer vaccinated a number of persons. The vessel then left for Port Townsend and arrived there on December 1, 1920.

The *Algonquin*, in command of Lieut. Commander W. A. Wiley, left Port Townsend on April 30, 1920, on her cruise in Alaskan waters, and arrived at Hydar, Alaska, on May 4. Four days later she proceeded to Ketchikan, where she remained until the 20th, awaiting the arrival of supplies forwarded to her from Seattle. On May 20 she left Ketchikan and took up the seal patrol the following day. Two herds, containing about eight seals each, were sighted off Sitka in the evening. The cutter continued the patrol until May 24, when she was called to Yakutat to transport a badly wounded Indian to the nearest hospital. * * * A rumor that about 500 fur seals had wintered in the vicinity of Attu was investigated, with the result that the report was found to be erroneous.

On July 6 Lieut. Commander W. A. Wiley, having become ill, was forced to relinquish command of the *Algonquin*, whereupon Lieut. Commander W. T. Stromberg assumed command. Lieut. Commander Wiley was invalided home.

During the months of June, July, and August the *Algonquin* made a number of cruises in the vicinity of the Pribilof Islands and to other places. While on these cruises she carried United States mail, transported passengers, delivered supplies for the Bureau of Education and others, and afforded medical aid to the sick.

On September 11 the *Algonquin* left Unalaska for a cruise to Unimak Island. Among others taken aboard for transportation to various points was Warden J. N. Braun, Bureau of Fisheries, who desired passage to St. George Island. On her return trip to Unalaska the cutter afforded transportation to Mr. H. Silverstone, of the Bureau of Fisheries.

On September 27, in compliance with the request of Mr. A. H. Proctor, superintendent Pribilof Islands, a board was appointed to examine and report upon the machinery of the U. S. F. S. *Eider*. The board recommended that urgent repairs be made to the vessel.

On October 10 the *Algonquin*, with the cutter *Bear* in tow, the latter having become disabled, set a course for Seattle and arrived there on October 20. * * * Preparations being completed, the cutter left Seattle October 28 on her return to Bering Sea and arrived at Unalaska on November 5. * * * Her duties being completed, the *Algonquin* left Unalaska on November 12 for Seattle. On her return trip she stopped at Akutan, Lost Harbor, the canneries at Ikatan and King Cove, Unga Harbor, Valdez, Juneau, and other places. * * * On November 28 the *Algonquin* left Juneau and arrived at Seattle on December 2, 1920.

The *Bear*, in command of Lieut. Commander F. S. Van Boskerck, sailed from Seattle on May 8, 1920, for Alaskan waters. While en route the commanding officer became ill, which necessitated the vessel's stopping at Alert Bay, British Columbia, where he disembarked to await transportation to Seattle. The executive officer, Lieut. Commander C. G. Roemer, then assumed command. The cutter left Alert Bay on May 18 and arrived at Unalaska on May 27, where she delivered the United States mail.

On June 6 she left for a cruise to the Pribilof Islands. A number of natives were afforded transportation on this trip. Navigation, especially in the vicinity of Nome, was rendered extremely difficult, owing to the prevalence of ice. On June 13 Lieut. Commander F. S. Van Boskerck boarded the vessel at Nome and resumed command. The *Bear* left for a cruise to St. Lawrence Island on June 22, but owing to severe ice conditions, it was found impossible to make a landing, so she returned to Nome, arriving there on September 21. * * *

On October 10 the *Bear*, in tow of the *Algonquin*, left Unalaska. On October 19 the cutter *Snohomish* made contact with the vessels and relieved the *Algonquin* of the tow, arriving at Bremerton Navy Yard on October 23, 1920.

The *Bothwell*, as part of the Bering Sea patrol force, reported for duty at Unalaska on August 1, 1920. This cutter made cruises to Bogoslof Island, Akutan, False Pass, King Cove, Latouche, and other places. While on these cruises the *Bothwell* collected certain geographic information, made reconnaissances of harbors, and delivered United States mail. On September 8 the *Bothwell* left Latouche on her return trip and arrived at Seattle on September 14, 1920.

In his report on the Bering Sea patrol Commander J. H. Brown states that the fishing fleets were not operating during the season in accordance with their usual schedule, and because of this fact but few of these vessels were fallen in with. He further states that there were no fishing vessels operating on the Sannak and Davidson Banks and but few on Slime Bank.

SEALING PRIVILEGES ACCORDED ABORIGINES.

One thousand two hundred and eighty-five fur-seal skins were taken by Indians off the coast of Washington during the months of April, May, and June, 1920. These skins, together with two more taken in June, 1919, were properly authenticated through the cooperation of A. D. Dodge, superintendent of the U. S. Indian School at Neah Bay, Wash. These seals were taken by Indians of the Washington coast in accordance with the privilege granted by the North Pacific Sealing Convention of July 7, 1911, and the act of Congress approved August 24, 1912. Of the total of 1,287 skins, 656 were from male seals, 630 from females, and one from a seal whose sex was not recorded.

JAPANESE SEALSKINS DELIVERED TO THE UNITED STATES.

On January 17, 1921, the Bureau was advised that 56 fur-seal skins, constituting 10 per cent of the total number taken from the Japanese herd on Robben Island in the season of 1920, were ready for delivery to a representative of the United States. Under the convention of July 7, 1911, the United States receives a share of skins taken from the Japanese herd. Instructions were issued for the shipment of these skins, and they reached San Francisco April 15, being forwarded at once to the Bureau's agents at St. Louis, where they were received on April 26. They will be dressed, dyed, and machined in the usual manner and sold for the account of the Government.

FUR-SEAL CENSUS, PRIBILOF ISLANDS, 1920.

By G. DALLAS HANNA.

I landed at the Pribilof Islands on June 16, 1920, from the U. S. naval radio tender *Saturn* for the purpose of making a census of the Alaska fur-seal herd which resorts there to breed. In order to complete the work it was necessary at various times to travel from St. Paul Island to St. George Island and vice versa. This was effected through the courtesy of the commanding officers of the *Saturn*, the Coast Guard cutter *Algonquin*, and the Bureau of Fisheries vessel *Eider*, to all of whom my appreciation is extended.

The census was made possible through the active cooperation of the superintendent of the Pribilof Islands, A. H. Proctor, in furnishing material and labor on St. Paul Island when necessary. C. E. Crompton, agent and caretaker, did likewise on St. George Island. E. C. Johnston, storekeeper on St. George Island, ably assisted in the actual census work as much as possible.

The methods used in counting and computing the various classes as given below were similar to those which have been in use for several years and which were outlined in the report of the Alaska Fisheries and Fur Industries in 1918, page 116.

PUPS.

DISTRIBUTION OF PUPS IN 1920.

| Rookery. | Date of counts. | Living pups. | Dead pups. | Total pups. | Per cent dead. |
|--------------------------|-----------------|--------------|------------|---------------------|----------------|
| ST. PAUL ISLAND. | | | | | |
| Kitovi..... | | 3,718 | 46 | ¹ 3,764 | 1.22 |
| Lukanin..... | | 2,853 | 79 | ¹ 2,932 | 2.69 |
| Gorbatch..... | | 9,970 | 281 | ¹ 10,251 | 2.74 |
| Ardiguen..... | | 1,163 | 17 | ¹ 1,180 | 1.41 |
| Reef..... | | 23,048 | 590 | ¹ 23,638 | 2.50 |
| Sivutch..... | | 8,281 | 94 | ¹ 8,375 | 1.12 |
| Lagoon..... | Aug. 12 | 8,333 | 8 | 841 | 2.35 |
| Tolstoi..... | | 16,898 | 388 | ¹ 17,286 | 2.24 |
| Zapadni..... | | 16,031 | 368 | ¹ 16,399 | 2.24 |
| Little Zapadni..... | | 12,214 | 280 | ¹ 12,494 | 2.24 |
| Zapadni Reef..... | Aug. 12 | 525 | 7 | 532 | 1.32 |
| Polovina..... | Aug. 11 | 5,794 | 212 | 6,006 | 3.53 |
| Polovina Cliffs..... | do..... | 2,511 | 62 | 2,573 | 2.41 |
| Little Polovina..... | | 1,690 | 21 | ¹ 1,711 | 1.23 |
| Morjovi..... | Aug. 10 | 2,818 | 118 | 2,936 | 4.02 |
| Vostochni..... | | 31,708 | 1,149 | ¹ 32,857 | 3.50 |
| Total..... | | 139,555 | 3,720 | 143,275 | 2.60 |
| ST. GEORGE ISLAND. | | | | | |
| North..... | | 8,944 | 182 | ¹ 9,126 | 1.99 |
| Staraya Artil..... | | 5,781 | 163 | ¹ 5,944 | 2.74 |
| Zapadni..... | Aug. 4 | 894 | 13 | 907 | 1.43 |
| South..... | do..... | 98 | 1 | 99 | 1.01 |
| East Reef..... | Aug. 5 | 2,543 | 28 | 2,571 | 1.09 |
| East Cliffs..... | | 5,493 | 112 | ¹ 5,605 | 2.00 |
| Total..... | | 23,753 | 499 | 24,252 | 2.06 |
| Total, both islands..... | | 163,308 | 4,219 | 167,527 | 2.52 |

¹ Based on estimated average harem.

The chief object in the counting of pups is the determination of the average number of cows to each bull, or the average harem. Since birth is given to but one young each year it follows that the determination of the number of young will give the number of breeding females, and by dividing this by the number of harem bulls found earlier in the season the average harem is determined.

Obviously the greater the number of pups counted the greater the accuracy of the census as a whole. Up to and including 1916 it was possible to count this class on all of the rookeries. In 1917, however, the greatly increased number of bulls prevented pup counting until such a late date that breeding areas could not all be gone over. The increase in size of the herd has further complicated matters. While it is not physically impossible to make a complete pup count when bulls are present in no greater numbers than in 1920, still a much larger force of counters would be required for the work than has heretofore been available.

Since 1917 a comparatively small proportion of the pups has been counted. Rookeries have been chosen, however, which were believed to represent the herd as a whole with regard to growth. They have been, in the main, the smaller ones, in order to reduce to a minimum the danger of loss from trampling by bulls and from smothering.

Neither of these factors enters largely into the operations if a competent force of white men is performing the work, because there are expedients which can be used in emergencies which effectually prevent deaths. For instance, if pups have piled up in the counting and are in danger of smothering, they can be scattered by a man wading into the mass. There is no other known means whereby the animals can be spread out quickly enough to prevent loss on a warm day. It so happens that the natives are entirely too irresponsible to be depended upon in such an emergency. In seven years of counting I have never seen one offer to do the scattering in such an emergency. It is obviously impossible for the person who does the actual counting to keep constant watch of the "podding" ahead of him, and if there should be no one else looking after that part of the work danger is sure to result: this is particularly true on the larger rookeries. Unfortunately the natives allowed eight pups to smother on Zapadni Reef rookery during the work on St. Paul in 1920. They have been included among the live pups on that rookery in the table because it is desirable to have the number of dead represent the natural loss only.

In selecting rookeries for counting in 1920 it seemed desirable in many ways to choose those which were counted in 1919. The working out of the average harem for those uncounted rookeries would then give results which were more strictly comparable than if new territory were selected.

While it seems reasonable to suppose that any one rookery would grow at the same rate as the herd, this is unfortunately far from the case. There is great variation among the several rookeries and on any one from year to year. This makes the estimating of the average harem on rookeries where pups have not been counted more or less uncertain. But unless all rookeries are counted—a manifestly impracticable task with a limited force and a large herd—no way to avoid the difficulty is known, and the matter must devolve upon the best judgment of those who have it in hand.

INCREASE OR DECREASE IN NUMBER OF PUPS IN 1920 FROM 1919.

| Rookery. | Total pups, 1919. | Total pups, 1920. | Numerical increase. | Increase (+) or decrease (-). |
|--------------------------|----------------------|----------------------|------------------------|--|
| ST. PAUL ISLAND. | | | | |
| | | | | <i>Per cent.</i> |
| Kitovi..... | 3,565 | 3,764 | 199 | + 5.58 |
| Lukanin..... | 2,788 | 2,932 | 144 | + 5.16 |
| Gorbatch..... | 12,308 | 10,251 | -2,057 | -16.65 |
| Ardiguen..... | 1,150 | 1,180 | 30 | + 2.61 |
| Reef..... | 22,457 | 23,638 | 1,181 | + 5.26 |
| Sivutch..... | 7,015 | 8,375 | 1,360 | +19.39 |
| Lagoon..... | 1,445 | 1,341 | -104 | -23.37 |
| Tolstoi..... | 16,027 | 17,286 | 1,259 | + 7.86 |
| Zapadni..... | 14,300 | 16,399 | 2,099 | +14.68 |
| Little Zapadni..... | 10,145 | 12,494 | 2,349 | +23.15 |
| Zapadni Reef..... | 1,604 | 1,532 | -72 | -11.92 |
| Polovina..... | 15,794 | 16,006 | 212 | + 3.66 |
| Polovina Cliffs..... | 12,209 | 12,573 | 364 | +16.48 |
| Little Polovina..... | 1,203 | 1,711 | 508 | +42.23 |
| Morjovi..... | 13,041 | 12,936 | -105 | - 3.45 |
| Vostochni..... | 30,863 | 32,857 | 1,994 | + 6.46 |
| Total..... | 133,914 | 143,275 | 9,361 | + 6.99 |
| ST. GEORGE ISLAND. | | | | |
| North..... | 8,802 | 9,126 | 324 | + 3.68 |
| Staraya Artil..... | 15,746 | 5,944 | 198 | + 3.44 |
| Zapadni..... | 1,857 | 1,907 | 50 | + 5.83 |
| South..... | 168 | 199 | 31 | +45.59 |
| East Reef..... | 12,367 | 12,571 | 204 | + 8.62 |
| East Cliffs..... | 5,418 | 5,605 | 187 | + 3.45 |
| Total..... | 23,258 | 24,252 | 994 | + 4.27 |
| Total, both islands..... | 157,172 | 167,527 | 10,355 | + 6.59 |

¹Pups counted.

It will be noted that upon some of the eight rookeries counted there has been no gain, whereas on others it has been considerable, and again that the gain on the lot has been only 3.77 per cent. This latter fact indicates very strongly that the gain of breeding cows has not been the 9 per cent which has been considered to be the normal rate.

It is true that the smaller rookeries do not increase as rapidly as the large ones, but there should not be this much discrepancy even though it is possible. It is entirely possible for the rookeries counted to have lost and the herd as a whole gain the normal amount, but it is not probable. The abnormal gain on the other rookeries would have been a noteworthy feature to a person who had had them in view during successive years. After a consideration of all of the factors which enter into the problem, the gains on the several rookeries have been estimated as shown in the above table. This, of course, is made up largely from the data on average harems (p. 116). It shows the gain of pups (and breeding cows) for the entire herd to be 6.59 per cent.

A noteworthy feature of the rookeries on which counts were made is the actual decrease in the number as well as the percentage of pups found dead in spite of an actual increase of total pups. This is entirely in accordance with predictions as to what would happen when the size of the harem would be increased. By using the figures of dead pups found on the various rookeries the numbers have been estimated for those which were not counted. This is shown in the table

above and illustrates the value of having a comparatively large average harem. The various proportions of massed areas where death rates are high to scattered rocky areas where they are low have been taken into consideration in arriving at the percentages. Also of prime importance in this connection is the fact that the size of the average harem in 1920 stands almost halfway between the figures for 1915 and 1916. It is reasonable to suppose that the percentage of dead pups would be governed thereby.

In the early days of pelagic sealing, when large numbers of dead pups were washed up by the surf, the impression was general that the animals were drowned by storms. The matter entered into international negotiations when it was maintained by the representatives of the Government of Great Britain that this was a prime cause of pup mortality. The fact that starvation was the cause of death as a result of the mothers having been killed by pelagic sealers was thereby concealed.

Dr. F. A. Lucas¹ has shown the subject in its true light and commented on the fallacy of the much-flaunted "deadly surf nip." By actual autopsy he demonstrated that the number of young animals drowned was insignificant.

I personally had never had an opportunity to make any observations on the subject until 1920, because violent storms had never occurred at the proper season during my seven years of work. But this year a heavy gale from the southwest drove an enormous surf into English Bay for three days during the latter part of July. It was precisely the time for deaths from drowning to occur, if such ever occur. Some pups are then dabbling in the edge of the water, while many others are young and weak.

After the storm thorough search of the entire stretch of English Bay beach was made, where over a thousand had been counted at one time during the days of pelagic sealing, but only 17 dead pups were found there. Not one of these 17 animals had drowned, and the majority of them were in an advanced stage of decomposition. They were simply some of the usual dead which had been washed off the rookery.

Thus the findings of Dr. Lucas in this respect are completely confirmed. Drowning is the cause of a very insignificant portion of the loss of fur seals.

The intestinal parasite *Uncinaria* may be present among the pups and may cause a few of the deaths recorded from year to year. Autopsies were made in a few cases in 1920 where decomposition had not proceeded too far, but in no instance could death be attributed to this cause. It may be that the parasite is epidemic at periodical intervals and will recur some time in the future. It is a point well worth keeping in mind by future investigators.

In 1915 the presence of a considerable number of animals, both young and adult, was noted and recorded which had the mange or some skin affection allied to it to a greater or less degree. Each year a few cases are seen, and they are usually marked by the presence of small, round, hairless spots. These are known in the fur trade by

¹ Fur Seal Investigations, 1896-97, pt. 3, pp. 83-84.

the erroneous term "rubbed spots." These are usually on portions of the anatomy which could not be "rubbed" under any circumstances. The number of cases of this disease gradually decreased to a minimum by 1917, which remained constant through 1920.

Ectoparasites of the fur seal are very rare, although the enormous amount of scratching which is visible in any "pod" would leave the casual observer with the impression that the opposite is the truth. In 1899 a louse, *Haematopinus callorhini* Osborn, was described from "a number of examples from the northern fur seal." And at the same time a tick, *Ixodes arcticus* Osborn, was described from a single individual.¹ I have made repeated search for these parasites, and several years ago located the louse on pups. Not all are afflicted by any means, but occasionally a few specimens can be secured from the eyelids and less often in the fur of the head. No positive information regarding the tick could be secured. A reward of \$1 per louse and \$5 per tick has been offered to the native workmen who kill and skin some 25,000 animals each year, but there have been only negative results. This leads me to believe that the louse is almost, if not wholly, confined to the pups, and very serious doubt is cast upon the *Ixodes arcticus* being a parasite of the fur seal at all.

COWS.

The number of breeding cows in the herd corresponds to the number of pups, since the one is derived directly from the other. There naturally exists in any year an excess of adult females over young, because there are always a few barren animals. The number, however, has never been considered other than inconsequential and is very properly ignored. The increase or decrease, in fact the existence of the species, is dependent upon the fertile cow; the others in no known way enter into commercial operations of man.

Formerly it was supposed that the cows which resorted to the hauling grounds with the bachelors were barren, but this is not the case at all. Thirteen cows which had been accidentally killed on the fields during the past four years have been examined and only one was found barren. Several of them had already given birth to young, but others had not, while the majority were 2-year-olds with reproductive organs normal in every way.

LOSS OF COWS ON THE ISLANDS.

The spreading of the bulls incident to the larger average harem produced a noticeable decrease in the death rate of cows on the breeding grounds. Since much of the turmoil and fighting of the past three years was thus done away with, such a result would be naturally expected. During the counting of 15,965 pups 9 dead cows were found. This is a percentage of 0.000563, which applied to the entire herd gives 94 as the total number. Comparable figures for preceding years were: 195 in 1919, 213 in 1918, 129 in 1917, and 39 in 1916. It shows that in spite of the increase in the herd there

¹ Fur Seal Investigations, 1896-97, pt. 3, p. 553.

has been an actual decrease in the number of dead cows, and it constitutes, along with the low death rate of pups, the strongest argument in favor of a reasonably large harem.

In addition to the decrease in number of dead cows found, there was a very noticeable decrease in the number of those which had been bitten and torn by the bulls. In no instance was an injury seen which was believed to be serious.

The closing of commercial operations on July 31 instead of August 10 is even more necessary now than heretofore, and it is again urged that this action be delayed no longer. It is well known that up to 1910 the Government prohibited the leasing companies almost every year from conducting sealing after July 31 on account of the number of cows which would otherwise be driven and unavoidably killed. This was a very efficient and sensible regulation and should by all means be inaugurated in the work of the Government.

During the commercial operations of 1917, 1918, and 1919 it has been pointed out many times that the resorting of the cows to the hauling grounds of the bachelors after August 1 interfered considerably with the work and caused the death of some of them. This flocking of the females to the hauling grounds is due chiefly to the fact that the breeding season has passed and they are free to move wherever they will. When bulls were abundant to replace each other on the rookeries, they held the cows longer in the harems. But the increase in the average harem in 1920 gave the cows a great deal more freedom than they had had for three years. This was evidenced by their flocking to the hauling grounds in greatly increased numbers. It was no uncommon thing on St. Paul for 250 cows to come up in a single drive after August 1. And on St. George they were so abundant that work was very seriously hampered. Naturally some of them were killed; not a large number, to be sure, but it is impossible to conduct the killing with reasonable dispatch so that all will be spared. Some accidents are unavoidable, because the 3-year-olds of both sexes are almost indistinguishable even to the practiced eye. The native workmen are ashamed of the work and unless importuned will not report the killing of a cow.

We may grant that the number of females killed by the extension of the season to August 10 is insignificant. Their value to the herd may not be as great as the increased revenue secured by the additional take of males; a simple calculation will demonstrate that. But the driving of these several thousand mothers, heavy with milk, is very inhumane to say the least. And if we may judge by the effect of similar exertion upon domestic animals permanent injury in many cases results. The long drives particularly tire them to the point of exhaustion, sometimes even to death. In dry weather the skin is worn from the flippers and leaves them raw or bleeding. All of these details are better left untold, but are given in hopes that the real importance of the situation will become apparent and that 1921 will see no driving permitted after July 31. We all of course know that it is not necessary to drive after that date in order to reduce the excess number of males satisfactorily. Forty years of commercial work has demonstrated that point.

LOSS OF COWS AT SEA.

It has been ascertained several times the past few years that the loss of cows at sea the first three years is approximately 50 per cent of all of those born. No data have come to hand which call for a revision of this result. It is an enormous death toll, and though it is almost certainly due to the work of some pelagic enemy, we know very little of it. Killer whales are known to devour the animals and are suspected of being their only enemy, yet proof is not to be had. Bryant has recorded the taking of 18 and 24 fur-seal pups, respectively, from the stomachs of two killers—\$2,000 meals, each of them. The investigation of this matter is one of the important tasks for the future. There are few studies which promise such fruitful results as would attend the successful solving of this problem. The protection afforded the cows and the consequent increased rate of growth of this class would be the permanent and most important benefit to the species and to man.

Actual figures as to the number of fur seals killed at sea under the treaty provisions allowing aborigines to hunt them are not yet available to me. Dispatches in the daily press, however, indicate that they are assuming proportions little short of alarming.

The proportions of the sexes taken in this pelagic catch are not known, but there is good reason to suppose that it consists largely of females. For the sake of convenience it may be assumed that 2,000 females were killed altogether on all coasts. This would reduce the Pribilof herd by double the number, or 4,000 in 1920, because the unborn pup is destroyed with the mother. In other words, the mainstay class of the herd has been reduced in a single season by over 1 per cent.

This matter is called to attention in the hope that a beginning may be made in solving the difficulty. Rather than have cows slaughtered it would be far preferable, if skins the Indians must have, to do as we have with Great Britain and Japan, give them an equivalent number of males from the land catch.

BRANDED ANIMALS.

Cows bearing the inverted T brand of 1912 on the top of the head were, as usual, in evidence on many of the rookeries. At Lukanin on St. Paul Island one was noted which was not believed to have been many hours out of the water. Two days later she had given birth to her pup but was located in a harem two bulls removed from where she was first seen. She was then seen each day until the eighth after her arrival. She could not be located later on the rookery, although she must have returned to nurse her pup. This confirms almost exactly a record made by W. I. Lembkey on the same rookery in 1902.

Further information was gained regarding those branded animals which may be conveniently classed as the 1902 series. A close study of them was begun in 1918 and the subject is dealt with at some length in the Alaska report for that year, pages 121 and 122.

The brands of this series consisted of one or more bars burned across the back or in a few cases with a longitudinal bar on the side combined with a cross bar. The work had for its object at the time of its inception the depreciation of the skin of the female to such an extent that it would be unprofitable for pelagic hunters to take it. The first experimental brands were put on in 1896, and when the operation was found to be practicable it was continued each season thereafter until 1902 on St. Paul Island and to 1903 on St. George Island, when it was abandoned. W. I. Lembkey states¹ that it was stopped in 1903 by departmental order. It was found a useless procedure in so far as the original objective was concerned.

A table was published in the 1918 report, page 122, which showed the totals branded each year on St. Paul. It included St. George also for 1896 and 1897. Subsequent records for the latter island could not then be located. Mr. C. E. Crompton has since found some of them and has kindly furnished them to me for use in this report. His records show the brandings on the smaller island for 1901 to 1903, inclusive, and they are embodied in the tables given below. Thus we now have the complete record of this work in so far as the island journals are kept, except for St. George Island, for the three years 1898, 1899, and 1900.

The records secured by Mr. Crompton failed to include one for October 12, 1903, of which I find a published statement in Appendix A to Hearings before House Committee on Expenditures in the Department of Commerce, page 100. It is there stated by Chichester that 274 pups were branded on that date. These have been added to the St. George totals for that year.

FEMALE PUPS BRANDED 1896 TO 1903.

| Year. | St. Paul Island. | St. George Island. | Total. |
|------------|---------------------|-----------------------|--------|
| 1896..... | 1 315 | 1 62 | 377 |
| 1897..... | ² 5,371 | ³ 1,880 | 7,251 |
| 1898..... | 2,363 | (4) | 2,363 |
| 1899..... | 2,191 | (4) | 2,191 |
| 1900..... | 1,698 | (4) | 1,698 |
| 1901..... | 4,173 | 656 | 4,859 |
| 1902..... | 1,416 | 1,326 | 2,742 |
| 1903..... | (4) | 1,352 | 1,352 |
| Total..... | 17,527 | 5,306 | 22,833 |

¹ Jordan and Clark, *Fur Seal Investigations*, 1896-97, p. 326.

² Murray, *ibid.*, pp. 337, 338.

³ Judge, *ibid.*, p. 338.

⁴ No record.

It seems desirable to record here the character of brands used when it has been possible to ascertain them. During several years when branding was done, a few cows were also captured and received the mark, but the number was so insignificant as to need no further mention in this connection.

¹ Appendix A, Hearings House Committee on Expenditures, Department of Commerce, p. 388. 1911.

FEMALE PUP FUR SEALS BRANDED ON ST. PAUL AND ST. GEORGE ISLANDS,
1896 TO 1903.

| Year. | Unknown. ¹ | Single bar. — | Double bar. = | Triple bar. = | Quadruple bar. = | Triple crossbar. = | Single diag- onal bar. / |
|-----------|-----------------------|--------------------|--------------------|------------------|------------------------|--------------------------|--------------------------------|
| 1896..... | | 191 | ² 2 | 62 | ² 9 | 124 | |
| 1897..... | | ³ 5,389 | ⁴ 1,133 | 847 | | | |
| 1898..... | | 2,029 | | | | | 334 |
| 1899..... | | 2,191 | | | | | |
| 1900..... | ⁵ 1,076 | 2,629 | | | | | |
| 1901..... | ⁶ 4,888 | | | | | | |
| 1902..... | 2,245 | 497 | | | | | |
| 1903..... | ³ 1,370 | | | | | | |

¹ Believed to have been single bar across back.² All cows.³ Includes 18 cows.⁴ Includes 100 cows.⁵ Includes 7 cows.⁶ Includes 29 cows.

Many records of "branding" after 1903 have been made, but they refer in every case, it is believed, to the marking of a bachelor reserve. This was first undertaken in 1904 and continued up to and including 1911. In every case, with the possible exception of the first year and irregular branding on St. George from time to time, permanent brands were not used. The hair was simply clipped from a spot on the back of the head so as to make the animal recognizable the remainder of that season. Unfortunately this process has been called "branding" almost always and has so confused the record of the real hot-iron work that the truth is in some cases in doubt.

A journal entry on September 25, 1901, was found which stated " * * * one [cow was seen] with a brand just behind its front flippers and another running parallel to its backbone, but a little to one side." In commenting upon this, C. E. Crompton says: "I positively saw [a cow with] this same brand at Staraya Artil while counting pups this year [1919]."

No record of the use of this brand has been found, but it was probably in 1898, or else no record was made when the work was done. Unfortunately the journal entries are usually very brief and do not describe the character of mark at all. As, for instance, "October 10, 1901, branded seals at Little East, 127 branded."

To have been a cow in 1901, the animal must have been born in 1898 or earlier. It is not likely that the odd brand was used on more than one batch of pups, nor in more than one year. This would make the cow seen by Mr. Crompton in 1919 at least 21 years of age. This is three years more than the maximum age which has heretofore been ascribed to a fur seal.

In all, seven cows of the 1902 series were seen on the various rookeries in 1920. Facilities for observation over the great mass of rookery areas are so poor, however, that this can represent but a small fraction of the number which must have actually been in existence.

It is most important to note that these animals were 18 years old, unless by possible chance they were all from the lot branded on St. George in 1903, when they would be 17. This is so highly improbable that it may be dismissed. Thus the maximum age of the cow is several years more than the most sanguine have previously suspected.

This leads to interesting speculation upon the comparative mortality of the sexes. But it will be sufficient here to dismiss the subject with the observation that no record is known to me of any individual bull having returned to the rookeries for more than three successive years. It is believed, however, that in the majority of cases they do return for at least five years.

Undoubtedly a mistake was made once in the branding in sorting the sexes, and a male pup got the mark across his back. He developed and occupied the same position on East Cliffs Rookery for three successive years, 1913, 1914, and 1915. In his last year he had to be at least 12 years old.

BULLS.

HAREM AND IDLE BULLS.

At the height of the breeding season the bulls which had harems and those usually termed idle were counted with the greatest possible accuracy. Steps have already been taken to adopt certain rookery improvements whereby this important count can be continued in the future, regardless of how large the herd becomes. Experiments with a stable skeleton tripod in 1920 demonstrated the superiority of such a structure over any form of elevating apparatus previously tried. The manner in which this was used is shown in figure 3.

By placing such a tripod near the beach line and having a skeleton walkway leading to it over the seals, a cheap and very effective means of counting large flat areas will be provided. It is expected that this will be tried out thoroughly in 1921. A few permanent markers on the breeding areas to divide them into sections should enable the enumerator to have absolute confidence in his result.

On account of the absence of some trustworthy manner to get up high enough to view the rookeries the harem counts since 1917, when bulls became very abundant, have not been as good on the large rookeries as desired. Many expedients have been used to help, such as counting from a boat, erecting markers of driftwood, climbing a long ladder, as well as natural elevations, which are sometimes reached with great danger; but all were more or less makeshifts, which it is planned shall be abandoned.

Although there doubtless is an error in the number of harems given for the larger rookeries, it is really very small and is conservatively estimated to be not greater than one-half of 1 per cent. The desirability of having even this small variation corrected is due to the fact that this is the basis of the census. A small error here will multiply throughout the computations.

The decrease in the number of bulls from 1919 was apparent not only in the records: on the rookeries it was very much safer to approach counting points, and disturbance of even the rear harems rarely resulted. There appeared to be a general "loosening up" of the compact areas maintained when the bulls were stationed closer together, so that the increase of area over 1919 appeared to be more than the figures indicated had been the increase in cows.

If it is possible to do so in the future, the counting dates on St. George Island should be set back to correspond with the beginning of the count on St. Paul Island. It has heretofore been customary to

make it after the St. Paul count, when one person was obliged to do both; and in 1920 it was thought best to continue the usual dates. However, if there is some one on the smaller island to whom the work can be delegated, it should be done. It was quite evident that harems had begun to break up, and some of the bulls which had completed their duties had resorted to the hauling grounds and elsewhere before the count was finished. Their places had been filled, of course, but it is better that the count be made just as the first harem masters are leaving.

Before the count was made it was plainly to be seen that the class formerly called "surplus bulls" was not large enough to warrant much killing. It had been the practice in 1917, 1918, and 1919 to class those animals which were found in apparently permanent position as "idle bulls" and others which evidently moved from place to place as "surplus bulls." Naturally, these latter did not constitute the whole of the class, because there were always some on the hauling grounds and in the water in front of the rookeries. Since conditions in 1920 had closely approached those of 1916 in this respect, it seemed entirely proper to follow the former practice and spare the class in the killings. By doing this there is a "margin of safety" for the breeding males which is maintained without entering into the computations.

HAREM AND IDLE BULLS AND PERCENTAGE OF IDLE BULLS TO HAREM BULLS COMPARED TO AVERAGE HAREM, 1920.

| Rookery. | Date. | Harem bulls. | Idle bulls. | Total. | Idle bulls to harem bulls. | Average harem. |
|--------------------------|---------|--------------|-------------|--------|----------------------------|----------------|
| ST. PAUL ISLAND. | | | | | <i>Per cent.</i> | |
| Kitovi..... | July 18 | 132 | 57 | 189 | 43.18 | 28.52 |
| Lukanin..... | do. | 95 | 28 | 123 | 29.47 | 30.86 |
| Gorbateh..... | July 19 | 253 | 40 | 293 | 15.81 | 40.52 |
| Ardiguen..... | do. | 40 | 8 | 48 | 20.00 | 29.50 |
| Reef..... | do. | 528 | 70 | 598 | 13.26 | 44.77 |
| Sivutch..... | do. | 190 | 60 | 250 | 31.58 | 44.08 |
| Lagoon..... | July 20 | 14 | 3 | 17 | 21.43 | 24.36 |
| Tolstoi..... | do. | 408 | 65 | 473 | 15.93 | 42.37 |
| Zapadni..... | do. | 423 | 85 | 508 | 20.09 | 38.77 |
| Sulhetunga..... | do. | | 16 | 16 | | |
| Little Zapadni..... | do. | 297 | 62 | 359 | 20.88 | 42.07 |
| Zapadni Reef..... | do. | 28 | 5 | 33 | 17.86 | 19.00 |
| Polovina..... | July 18 | 177 | 75 | 252 | 42.37 | 33.93 |
| Polovina Cliffs..... | do. | 86 | 24 | 110 | 27.91 | 29.92 |
| Little Polovina..... | do. | 49 | 48 | 97 | 97.06 | 34.92 |
| Morjovi..... | July 17 | 97 | 99 | 196 | 102.06 | 30.27 |
| Vostochni..... | do. | 725 | 333 | 1,058 | 45.93 | 45.32 |
| Total..... | | 3,542 | 1,078 | 4,620 | 30.43 | 40.45 |
| ST. GEORGE ISLAND. | | | | | | |
| North..... | July 23 | 199 | 17 | 216 | 8.54 | 45.86 |
| Staraya Artil..... | do. | 112 | 20 | 132 | 17.86 | 53.07 |
| Zapadni..... | July 22 | 27 | 5 | 32 | 18.52 | 33.59 |
| South..... | do. | 4 | | 4 | | 24.75 |
| East Reef..... | do. | 67 | 28 | 95 | 41.79 | 38.37 |
| East Cliffs..... | do. | 115 | 13 | 128 | 11.30 | 48.74 |
| Total..... | | 524 | 83 | 607 | 15.84 | 46.28 |
| Total, both islands..... | | 4,066 | 1,161 | 5,227 | 28.55 | 41.20 |

A comparison of the foregoing table with the corresponding one for 1919 shows that there has been a reduction of harem bulls of 1,092 and of idle bulls of 1,078. There were even fewer animals in

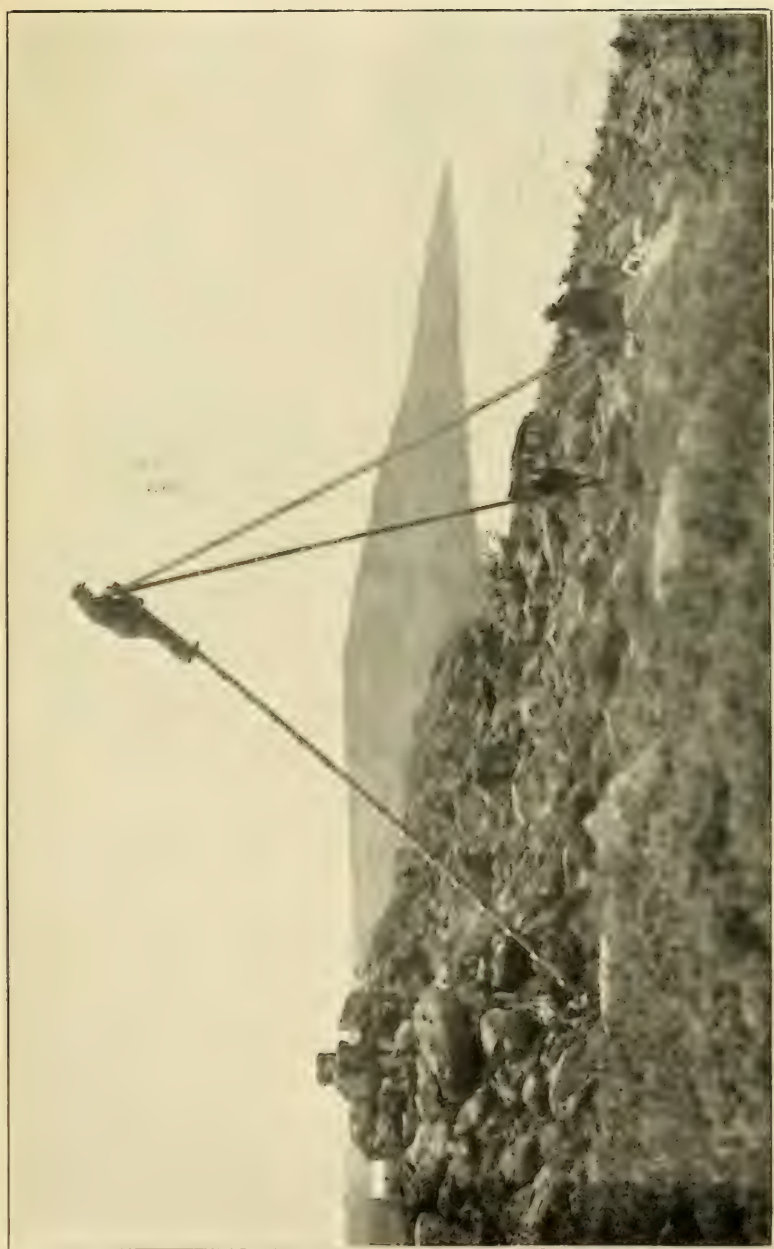


FIG. 3.—OBSERVATION TRIPOD FOR USE IN TAKING FUR-SEAL CENSUS.

these classes in 1920 than there were in 1917. Actual numbers, however, mean nothing in this connection. The important features are the ratio of idle bulls to harem bulls and the average harem. Conditions for the series of years 1912 to 1920 are best shown in tabular form as follows:

VARIATIONS IN ADULT BULL CLASSES AND RATIO OF IDLE TO HAREM BULLS, 1912 TO 1920.

| Year. | St. Paul Island. | | | | St. George Island. | | | | Both Islands. | | | |
|--------|------------------|-------|----------------|----------------|--------------------|-------|----------------|----------------|---------------|-------|----------------|----------------|
| | Harem. | Idle. | Ratio. | Average harem. | Harem. | Idle. | Ratio. | Average harem. | Harem. | Idle. | Ratio. | Average harem. |
| | | | <i>Per ct.</i> | | | | <i>Per ct.</i> | | | | <i>Per ct.</i> | |
| 1912.. | 1,077 | 93 | 8.63 | 65.0 | 261 | 20 | 7.11 | 42.5 | 1,358 | 113 | 8.32 | 60.4 |
| 1913.. | 1,142 | 77 | 6.74 | 69.6 | 261 | 28 | 10.72 | 49.1 | 1,403 | 105 | 7.48 | 65.8 |
| 1914.. | 1,516 | 159 | 12.0 | 60.3 | 243 | 13 | 5.3 | 57.1 | 1,559 | 172 | 11.0 | 59.8 |
| 1915.. | 1,789 | 346 | 30.52 | 49.27 | 362 | 127 | 35.08 | 42.51 | 2,151 | 673 | 31.28 | 48.13 |
| 1916.. | 2,948 | 2,278 | 77.27 | 33.53 | 552 | 354 | 64.13 | 32.82 | 3,500 | 2,632 | 75.20 | 33.42 |
| 1917.. | 4,106 | 2,341 | 56.19 | 26.08 | 684 | 365 | 53.36 | 28.26 | 4,850 | 2,706 | 55.79 | 26.39 |
| 1918.. | 4,610 | 2,245 | 48.69 | 26.59 | 731 | 199 | 27.11 | 27.65 | 5,344 | 2,444 | 45.73 | 26.74 |
| 1919.. | 4,573 | 2,158 | 47.19 | 29.28 | 585 | 81 | 13.84 | 39.76 | 5,158 | 2,239 | 43.40 | 30.47 |
| 1920.. | 3,542 | 1,078 | 30.43 | 40.45 | 524 | 83 | 15.83 | 46.28 | 4,066 | 1,161 | 28.55 | 41.20 |

Thus the average harem has increased from 26 to 41, whereas there are 28 per cent as many idle bulls as harem bulls. When this is compared with average harems of 60 and 65 and with percentages of idle bulls from 8 to 11 found in 1912 to 1914, it is at once seen there was still a small oversupply of males in 1920 if conditions in the former years be considered ideal. It has not been contended that there were too few bulls in those years for breeding requirements, although it is generally believed that the ideal average harem is between 40 and 50. This was the condition in 1920, and if it can be maintained with about the same averages and ratios throughout commercial operations, those having charge of the business may well feel gratified at their success.

If we pass without comment on the good or bad judgment shown in creating the enormous surplus of male life with the closed season of 1912 to 1917, still those who have had the administration of the herd in hand deserve great commendation for bringing back an ideal condition in the short space of three years.

AVERAGE HAREM.

The average harem was determined from actual pup counts in 1920 on the same rookeries as in 1919. The gains shown on these rookeries were used as the basis in the computation of the average harem for all rookeries. Due consideration was given in every case to the topography of the various breeding areas, since it is well known that harems are smallest on rough, rocky places. Also it is known that large massed areas grow more rapidly than small scattered ones. Thus, while the harem increased but 6 on the small rookeries counted, it was computed to have increased by 10 for the herd as a whole. A good illustration of this point may be seen in the figures for 1913, when there were over 80 cows to each bull on the average for four rookeries, while many of the smaller ones ran below 40. For purposes of comparison the average harems in 1919 are given, showing graphically the increase in size of harems.

AVERAGE HAREM IN 1920 FOR ALL ROOKERIES.

| Rookery. | Breeding cows. | Harem bulls. | Average harem 1920. | Average harem 1919. |
|----------------------------------|----------------|--------------|---------------------|---------------------|
| ST. PAUL ISLAND. | | | | |
| Kitovi..... | 3,764 | 132 | ¹ 28.52 | ¹ 23.00 |
| Lukanin..... | 2,932 | 95 | ¹ 30.86 | ¹ 25.34 |
| Gorbach..... | 10,251 | 253 | ¹ 40.52 | ¹ 34.00 |
| Ardiguen..... | 1,180 | 40 | ¹ 29.50 | ¹ 25.00 |
| Reef..... | 23,638 | 528 | ¹ 44.77 | ¹ 31.19 |
| Sivutch..... | 8,375 | 190 | ¹ 41.08 | ¹ 30.50 |
| Lagoon..... | 341 | 14 | ² 24.36 | ² 26.18 |
| Tolstoi..... | 17,286 | 408 | ¹ 42.37 | ¹ 29.79 |
| Zapadni..... | 16,399 | 423 | ¹ 38.77 | ¹ 26.19 |
| Little Zapadni..... | 12,494 | 297 | ¹ 42.07 | ¹ 29.49 |
| Zapadni Reef..... | 532 | 28 | ² 19.00 | ² 21.57 |
| Polovina..... | 6,006 | 177 | ² 33.93 | ² 30.18 |
| Polovina Cliffs..... | 2,573 | 86 | ² 24.92 | ² 23.01 |
| Little Polovina..... | 1,711 | 49 | ¹ 34.92 | ¹ 31.66 |
| Morjovi..... | 2,936 | 97 | ² 30.27 | ² 20.69 |
| Vostochni..... | 32,857 | 725 | ¹ 45.32 | ¹ 30.74 |
| Total..... | 143,275 | 3,542 | 40.45 | 29.28 |
| Total for rookeries counted..... | 12,388 | 402 | 30.82 | 25.19 |
| ST. GEORGE ISLAND. | | | | |
| North..... | 9,126 | 199 | ¹ 45.86 | ¹ 39.12 |
| Staraya Artil..... | 5,944 | 112 | ¹ 53.07 | ² 46.34 |
| Zapadni..... | 907 | 27 | ² 33.59 | ² 31.74 |
| South..... | 99 | 4 | ² 24.75 | ² 13.60 |
| East Reef..... | 2,571 | 67 | ² 38.37 | ² 31.56 |
| East Cliffs..... | 5,605 | 115 | ¹ 48.74 | ¹ 42.00 |
| Total..... | 24,252 | 524 | 46.28 | 39.76 |
| Total for rookeries counted..... | 3,577 | 98 | 36.50 | 39.42 |
| Total, both islands..... | 167,527 | 4,066 | 41.20 | 30.47 |

¹ Estimate.² Pups counted.

LOSSES OF BULLS AND YOUNG MALES.

In 1911 and 1912, when legislation was proposed which would prohibit the killing of the surplus males of the fur-seal herd on land, the principal objection raised was that a vast oversupply of breeding males would result. In view of the fact that commercial operations were curtailed for six years, it will be profitable to review conditions from the standpoint of the effect of the class on the herd.

The law which established the closed period of 1912 to 1917 became effective on August 24 of the former year. The action had been anticipated, however, and, since the intention of Congress was obvious, it was put into effect in the killing season of 1912. This made the closed period cover six seasons. It will be recalled that the herd had been reduced to its lowest point during American ownership in 1911 through the activities of vessel killings at sea. The major portion of the pelagic catch consisted of females. The surplus males up to 1910 were taken on land by private corporations which had leased the privilege, and in 1910 and 1911 by the agents of the Government. Under those methods over 95 per cent of the males were removed and there were left for breeding an average of approximately 1 male to 60 females. Investigators generally agreed that this ratio was sufficient.

On account of the low figure to which the herd had been reduced, however, it was feared that the vitality of the species had been

impaired. It was argued that the herd would be benefited by leaving it unmolested by man for a period of years and allowing natural selection to become effective for a time in reducing the number of males.

In a state of nature the polygamous habits of the animals are such that the removal of the excess number of males is effected by fighting. It was believed by some that only the most virile of the males would survive the battles which would inevitably result from the failure of man to remove the excess. An improvement in the breeding stock was thus anticipated. Apparently the fact was overlooked that when a finish fight between bulls takes place neither the victor nor the vanquished is of much value thereafter as a breeder. Both are exhausted.

When the law of 1912 became effective there were 1,358 harem bulls in the herd, or 1 to 59.8 cows. Naturally, no immediate increase in the number of bulls nor reduction in the average harem could be expected, hence we find practically the same condition in 1913 and 1914. It was necessary to wait until those animals 3 years old and over in 1912 became old enough and strong enough to enter the rookeries before any result would become noticeable.

In 1915 we find a slight increase in the number of bulls. The average harem was 48.13. But since those animals 3 years old in 1912 could not have entered the rookeries until they were 8 years old, or in 1917, the cause of this increase in bulls must be looked for elsewhere than from the closed season. It could not possibly result from anything but ample reserves made by the Government agents during the commercial operations in the seasons immediately preceding 1912.

The same is true for the season of 1916, when there was a further decrease in the average harem. This was undoubtedly the result of reserves made during the season of 1911 and previously.

In 1917 there was an enormous increase in the number of bulls. This was the first influx due to the closed season. The average harem went down to 26.39, which we now know to be about as small as it can go, regardless of the number of males present. The habits of the bulls are such that the massed areas would be the scene of continual and disastrous fighting if the males were separated by much less than the space occupied by the minimum average harem.

A further large increase in males in 1918 was due to the absence of killing in 1913. This increase, however, failed to reduce the size of the average harem from the minimum found the previous year. There was thus built up an enormous excess of male life, which no known means enabled us to estimate with reasonable accuracy. There were no data upon which to estimate a natural loss. Fortunately for these computations, we have had the ages of animals killed determined for several years. This is accomplished on the killing fields by measuring the length of the freshly killed animal by means of a pair of beam calipers. The measuring of a series of branded males of known age permitted the establishment of standards showing the prevailing body length for each age, and the recording, in the proper categories, of field measurements of seals killed completed the classification.

By consistent efforts the greater portion of the excess of males had been removed by 1920, so that the average harem increased to

41.20. Recently acquired information enabled the computation with reasonable accuracy of the number of adults in existence in addition to the harem bulls and idle bulls. And since we know the number of births, it now becomes possible for the first time to compute the average natural loss from the third year to maturity. It gives the first concrete information ever available upon the size of a reserve which should be made in the third year to supply the herd with stock at maturity.

In order to present the figures intelligibly, the following table has been prepared. The figures have been taken from the various census reports since 1914. Nothing has been deducted for natural mortality from the third year on. Only animals killed have been removed from the various classes.

ASSUMED MALE STRENGTH OF HERD IN 1920 EXCLUSIVE OF NATURAL LOSS.

| Class. | Number in 1916. | Killed in census year. ¹ | | | | | Remain- der less killings. |
|--------------------------|--------------------|--|-------|-------|-------|-------|----------------------------------|
| | | 1916 | 1917 | 1918 | 1919 | 1920 | |
| 3-year-olds in 1912..... | 2,005 | | | | | | 2,005 |
| 3-year-olds in 1913..... | 11,271 | 104 | | | | | 11,167 |
| 3-year-olds in 1914..... | 15,848 | 354 | 97 | 647 | | | 14,750 |
| 3-year-olds in 1915..... | 18,282 | 2,855 | 614 | 1,058 | 4,302 | | 9,453 |
| 3-year-olds in 1916..... | 19,402 | (*) | 2,771 | 4,690 | 2,950 | 2,001 | 6,990 |
| Total..... | 66,808 | Total bulls remaining in 1920 if no natural loss occurred..... | | | | | 44,365 |

¹ Animals killed in the fall of one year have been added to the killings of the following summer.

² Killings already deducted.

This table shows that out of a stock of 66,808 animals which reached the age of 3 years from 1912 to 1916, inclusive, there would remain in 1920, 44,365 if there had been no natural loss. These animals would all be 7 years old or over in 1920. The younger ages do not enter into consideration here because they could not have been counted among rookery bulls that season.

It now remains to properly divide this total among the various years and classes and derive the percentage therefrom. The problem is difficult because so many factors enter therein to modify the result, and it is necessary to take these into consideration.

As an illustration, we may consider the 3-year-old class of 1914. The animals composing it were not subjected to any unusual conditions until the seventh year. Only the usual rate of natural mortality would therefor apply during these years. But when they were approaching maturity in numbers vastly exceeding the requirements of the cows, fighting for elimination began. The younger animals would naturally be vanquished. Thus the loss during the seventh year would be excessive and still more so during the eighth and ninth. In later years the percentage of loss would doubtless increase at a regular rate and 100 per cent would be reached at maximum old age. This, unfortunately, is not known and a figure must be assumed therefor. At the present time we seem not to have any good grounds to believe many bulls exceed 15 years. This, of course, is less than the

age of females, but there are so many differences between the sexes of this species that the age of the male can no longer be based upon that of the female.

The conditions outlined above are those which are believed to exist when there is a great excess of males. If they had been removed by man so that only approximately enough remained for breeding purposes, the losses during the seventh, eighth, and ninth years would not be so heavy. Also it is probable that the bulls live longer when there is no fighting than when they have to wear themselves out in maintaining a harem position.

It, therefore, becomes apparent that conditions which obtained during 1917, 1918, 1919, are not normal and may never occur again. Everything now indicates that the younger animals suffered a practically constant mortality until the seventh year, and then their losses amounted to 50 per cent or more annually. Under normal conditions with the great excess removed by man, the loss after the seventh year would be variable and dependent upon the care given to the reserving of a proper number of bulls.

It seems unnecessary here to make arbitrary assumptions for the annual losses of the class which was termed in 1917-1919 "surplus bulls." It is definitely known that they were greater than the losses assumed and deducted. Thus in 1919, 50 per cent was estimated to have been the loss from the third year to and including the surplus bull class; that is, animals 7 years old and over. If the loss had been estimated at 50 per cent from the third year to the seventh and at least that much annually thereafter, it would have come nearer the actual condition. But there was nothing until 1920 which would cause one to suspect that the loss had been so enormous.

It now remains to determine what the annual loss of males is from the third year on, when average conditions accompanying commercial work exist. A division which is more or less arbitrary for all ages is as follows: First year, 35 per cent; second, 15 per cent; third, 10 per cent; fourth, 10 per cent; fifth, 10 per cent; sixth, 20 per cent; seventh, 20 per cent; eighth, 25 per cent; ninth, 30 per cent; tenth, 40 per cent; eleventh, 50 per cent; twelfth, 60 per cent; thirteenth, 70 per cent; fourteenth, 80 per cent; fifteenth, 100 per cent.

Considerable of the above is conjecture, but it is believed to represent fairly accurately the conditions existing in 1920. It will be noted that there is a slight revision of the percentages lost from the first to the third year. This does not materially affect the result and gives a working basis for the future. Doubtless additional investigation will adjust any irregularities in the table. It has been used in the preparation of the final census for 1920.

These new percentages of loss were obtainable in 1920, because early in the season it was seen that the surplus believed to be in existence from the accumulation of the closed period did not appear. It was evident that if the bulls were coming at all they would have been at the islands before the middle of July. Since they did not appear at that time it was recommended that no more be removed from the herd. As it turned out the counts at the height of the season showed that a few more could have been removed with safety.

COMPLETE CENSUS OF FUR SEALS AS OF AUGUST 10, 1920.

| | | |
|---|---------|--------|
| Pups, counted and estimated | 167,527 | |
| Breeding cows, 3 years old and over, by inference | 167,527 | |
| Harem bulls, counted | 4,066 | |
| Idle bulls, counted | 1,161 | |
| Yearlings, male and female, estimated: | | |
| Pups born in 1919 | 157,172 | |
| Deduct 35 per cent for natural mortality | 55,010 | |
| Yearlings, both sexes, beginning 1920 | 102,162 | |
| Yearling females, 50 per cent, Aug. 10, 1920 | 51,081 | 51,081 |
| Yearling males, beginning of 1920 | 51,081 | |
| Yearling males killed in 1920 | 7 | |
| Yearling males, Aug. 10, 1920 | | 51,074 |
| 2-year-olds, male and female, estimated: | | |
| Yearling females, Aug. 10, 1919 | 46,447 | |
| 15 per cent deducted for natural mortality | 6,967 | |
| 2-year-old females, Aug. 10, 1920 | | 39,480 |
| Yearling males, Aug. 10, 1919 | 46,444 | |
| Yearling males killed, fall of 1919 | 7 | |
| Yearling males, end of 1919 | 46,437 | |
| 15 per cent deducted for natural mortality | 6,966 | |
| 2-year-old males, beginning of 1920 | 39,471 | |
| 2-year-old males, killed in 1920 | 360 | |
| 2-year-old males, Aug. 10, 1920 | | 39,111 |
| 3-year-old males, estimated: | | |
| 2-year-old males, Aug. 10, 1919 | 33,081 | |
| 2-year-old males killed, fall of 1919 | 214 | |
| 2-year-old males, end of 1919 | 32,867 | |
| 10 per cent deducted for natural mortality | 3,287 | |
| 3-year-old males, beginning of 1920 | 29,580 | |
| 3-year-old males killed in 1920 | 18,831 | |
| 3-year-old males, Aug. 10, 1920 | | 10,749 |
| 4-year-old males, estimated: | | |
| 3-year-old males, Aug. 10, 1919 | 13,596 | |
| 3-year-old males killed fall of 1919 | 820 | |
| 3-year-old males, end of 1919 | 12,776 | |
| 10 per cent deducted for natural mortality | 1,278 | |
| 4-year-old males, beginning of 1920 | 11,498 | |
| 4-year-old males killed in 1920 | 5,831 | |
| 4-year-old males, Aug. 10, 1920 | | 5,667 |
| 5-year-old males, estimated: | | |
| 4-year-old males, Aug. 10, 1919 | 5,747 | |
| 4-year-old males killed fall of 1919 | 66 | |
| 4-year-old males, end of 1919 | 5,681 | |
| 10 per cent deducted for natural mortality | 568 | |
| 5-year-old males, beginning of 1920 | 5,113 | |
| 5-year-old males killed in 1920 | 106 | |
| 5-year-old males, Aug. 10, 1920 | | 5,007 |

6-year-old males, estimated:

| | | |
|---|--------|-------|
| 5-year-old males, Aug. 10, 1919 | 5,282 | |
| 5-year-old males killed fall of 1919 | 37 | |
| 5-year-old males, end of 1919 | 5,245 | |
| 20 per cent deducted for natural mortality | 1,049 | |
| 6-year-old males, beginning of 1920 | 4,196 | |
| 6-year-old males killed in 1920 | 43 | |
| 6-year-old males, Aug. 10, 1920 | | 4,153 |
| Surplus bulls (7-year-olds and over), estimated: | | |
| 6-year-old males, Aug. 10, 1919 | 8,991 | |
| 6-year-old males killed fall of 1919 | 300 | |
| 6-year-old males, end of 1919 | 8,691 | |
| 20 per cent deducted for natural mortality | 1,738 | |
| 7-year-old males, beginning of 1920 | 6,953 | |
| Surplus bulls, Aug. 10, 1919 | 9,619 | |
| Surplus bulls killed fall of 1919 | 980 | |
| Surplus bulls, end of 1919 | 8,639 | |
| 30 per cent deducted for natural mortality | 2,592 | |
| Remaining surplus bulls for 1920 | 6,047 | |
| Breeding bulls of 1919 | 7,397 | |
| 30 per cent deducted for natural mortality | 2,219 | |
| 1919 bulls remaining in 1920 | 5,178 | |
| Breeding bulls in 1920 | 5,227 | |
| 1919 bulls remaining, deducted | 5,178 | |
| Increment of new bulls in 1920 | 49 | |
| 7-year-old males computed for 1920 | 6,953 | |
| Surplus bulls computed for 1920 | 6,047 | |
| Total theoretical surplus bull stock for 1920 | 13,000 | |
| 7-year-olds and over killed in 1920 | 721 | |
| Total surplus in 1920 | 12,279 | |
| Increment of new breeding bulls in 1920, deducted | 49 | |
| Surplus bulls in 1920 | 12,230 | |
| 50 per cent deducted for abnormal losses due to excessive number of bulls | 6,115 | |
| Surplus bulls, Aug. 10, 1920 | | 6,115 |

RECAPITULATION.

| | |
|--|---------|
| Pups | 167,527 |
| Cows | 167,527 |
| Harem bulls | 4,066 |
| Idle bulls | 1,161 |
| Yearling females | 51,081 |
| Yearling males | 51,074 |
| 2-year-old females | 39,480 |
| 2-year-old males | 39,111 |
| 3-year-old males | 10,749 |
| 4-year-old males | 5,667 |
| 5-year-old males | 5,007 |
| 6-year-old males | 4,153 |
| Surplus bulls (males 7 years old and over) | 6,115 |
| Total | 552,718 |

NATURAL-HISTORY RECORDS OF PRIBILOF ISLANDS.

By G. DALLAS HANNA.

It seems to be highly desirable that there shall be published in a readily accessible place a résumé of the scientific work which has been done in connection with the biology of the Pribilof Islands. This group of islands has been more intensively studied than any other similar area in Alaska and will continue, doubtless, to attract attention in the future. Records of publications on the various groups of plants and animals are often widely scattered, and employees of the Bureau stationed on the islands have little opportunity to search for them.

The last bibliography of the subject was published in 1915 in a report by Osgood, Preble, and Parker.¹ This list was known to be incomplete at the time of its preparation and was intended to cover the subject "fur seals" only. Yet it is very valuable to anyone who has occasion to study the literature of the Pribilof Islands.

The following list is the result of note taking through several successive years and is intended to cover the general natural history of the islands in so far as I have the records. It also is known to be incomplete, but it takes up the most important work which has been done since the appearance of the above-mentioned bibliography. In some cases papers published prior to 1914 are included because of their interest to island students.

It should be explained that in addition to the following titles many Pribilof Islands records are contained in general publications which are not listed. For instance, Dall² has mentioned a large number of marine mollusks from the Pribilofs in his work on Northwest Coast Shells. The same is true of birds in Ridgway's "Birds of North and Middle America,"³ Hamilton's "Coleoptera of Alaska,"⁴ Evermann and Goldsborough's "Fishes of Alaska,"⁵ and others. A new work is expected from the National Herbarium soon and it will contain full records of Alaska plants, including those from the Pribilof Islands.

The report of Alaska Fisheries and Fur Industries in 1918 (Bureau of Fisheries Document No. 872, pp. 105-107) contained a check list of birds of the Pribilof Islands, Alaska, with the names of persons first recording the species from the islands. This list contained names of 129 species and subspecies. It has been increased by six, the first three added in 1920, the fourth restored on evidence col-

¹ The Fur Seals and Other Life of the Pribilof Islands, Alaska, in 1914. Bulletin, Bureau of Fisheries, Vol. XXXIV, 1914 (1916), pp. 149-167. Washington, 1915.

² U. S. National Museum, Bulletin 112. 1921.

³ U. S. National Museum, Bulletin 50.

⁴ Transactions, American Entomological Society, Vol. XXI, pp. 1-38. 1894.

⁵ Bulletin, U. S. Bureau of Fisheries, Vol. XXVI, pp. 219-360. 1906.

lected during the winter of 1919-20, and the remaining two recorded in 1921:

Limnocyptes gallinula, European Jack-snipe.^{1, 2}

Macrorhamphus griseus scolopaceus, Long-billed Dowitcher.¹

Passerella iliaca unalaschensis, Shumagin Fox Sparrow.¹

Corvus corax principalis, Northern Raven.

Micropus pacificus, Japanese Swift.^{2, 3}

Loxia leucoptera leucoptera, White-winged Crossbill.³

This brings the total number of species known from the Pribilof Islands up to 135. All but six of these records are supported by specimens in some public museum. Since the 1918 list was compiled the little brown crane has been collected, but the restoration of the raven keeps the number of uncollected species the same as at that time.

In the paper by Mailliard and Hanna⁴ a few corrections of former records were made. It was decided that the citation of *Arquatella maritima couesi*, Aleutian sandpiper, from the Pribilof Islands, by Seale⁵ was unwarranted, and the record would have to be based on later work. A specimen taken on St. George Island February 12, 1917, by G. Dallas Hanna, was referred to in support of the record. The specimen is now in the National Museum.

The credit for recording *Pisobia acuminata*, sharp-tailed sandpiper, was given to Bishop⁶ in the 1918 list as Grinnell⁷ had done. Seale, however, had recorded it three years previously.⁴

The record of *Larus hyperboreus hyperboreus*, glaucous gull, by Oberholser, cited in the 1918 list, is rather obscure. It is to be found in The Auk, Volume XXXV, No. 4, page 470, October, 1918. The subspecies *L. h. barocianus*, first taken by Palmer, is also listed by Oberholser from the Pribilofs on page 473 of his article.

BIBLIOGRAPHY.

FUR SEALS.

APPENDIX A.

1911. Appendix to Hearings before the Committee on Expenditures in Department of Commerce and Labor, House Resolution No. 73, to investigate the fur-seal industry of Alaska; June 28 and July 6, 1911. [This publication is said to contain all the correspondence pertaining to the Pribilof Islands from 1905 to date of publication. It contains a wealth of information on administrative matters and natural history. The more important reports in the document are listed in this bibliography under the names of their authors.]

CLARK, GEORGE A.

1911. Report of the seal census for 1909. Appendix A, Hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 827-897; comments thereon by W. I. Lembecky, pp. 898-903. Also preliminary report dated August 15, 1909, pp. 715-716 and 826-827.

¹ Hanna, G. Dallas: New and interesting records of Pribilof Island birds. Condor, Vol. XXII, No. 5, pp. 173-175, September, 1920.

² New to North America.

³ Mailliard, Joseph, and G. Dallas Hanna: New bird records for North America with notes on the Pribilof Islands list. Condor, Vol. XXIII, No. 3, pp. 93-95, 1921.

⁴ Seale, Alvin: Notes on Alaskan water birds. Proceedings, Academy of Natural Sciences, Philadelphia, Vol. 50, 1898, p. 139.

⁵ Bishop, Louis B.: Birds of the Yukon region, with notes on other species. North American Fauna, Vol. 19, p. 66, 1901.

⁶ Grinnell, Joseph: Record of Alaskan Birds in the collection of the Leland Stanford Junior University. Condor, Vol. III, p. 19, 1901.

EVERMANN, BARTON WARREN.

1919. The northern fur-seal problem as a type of many problems of marine zoology. *Scientific Monthly*, September, 1919, pp. 263-282. [Fully illustrated.]

HANNA, G. DALLAS.

1917. Census of the fur seal herd. In *Alaska fisheries and fur industries in 1915*, by Ward T. Bower and Henry D. Aller, Appendix III, Report, U. S. Commissioner of Fisheries, 1915, pp. 83-96.
- 1917a. Census of the fur seal herd. In *Alaska fisheries and fur industries in 1916*, by Ward T. Bower and Henry D. Aller, Appendix II, Report, U. S. Commissioner of Fisheries, 1916, pp. 91-98.
1918. Fur-seal census, Pribilof Islands, 1917. In *Alaska fisheries and fur industries in 1917*, by Ward T. Bower and Henry D. Aller, Appendix II, Report, U. S. Commissioner of Fisheries, 1917, pp. 97-123.
1919. Fur-seal census, Pribilof Islands, 1918. In *Alaska fisheries and fur industries in 1918*, by Ward T. Bower, Appendix VII, Report, U. S. Commissioner of Fisheries, 1918, pp. 116-128.
1920. Fur-seal census, Pribilof Islands, 1919. In *Alaska fisheries and fur industries in 1919*, by Ward T. Bower, Appendix IX, Report, U. S. Commissioner of Fisheries, 1919, pp. 106-117.
1921. Fur-seal census, Pribilof Islands, 1920. In *Alaska fishery and fur-seal industries in 1920*, by Ward T. Bower, Appendix VI, Report, U. S. Commissioner of Fisheries, 1920, pp. 104-121.

HEATH, HAROLD.

1911. Fur-seal investigations in 1910. Appendix A, hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 1209-1225; uncorrected page proof. The full report appeared as U. S. Bureau of Fisheries Document No. 748. Quoted complete in *Fur Trade Review* for November, 1911, pp. 79-86.

LEMBKEY, W. I.

1911. Reports for years 1905 to 1910, inclusive. Appendix A, hearings before the Committee on Expenditures in Department of Commerce and Labor as follows:
 1905: pp. 157-208.
 1906: pp. 260-319.
 1907: Preliminary, pp. 482-485; annual, pp. 486-533. Also published as Senate Document No. 376, 60th Cong., 1st sess.
 1908: pp. 593-658. Also published as House Document No. 63, 62d Cong., 1st sess.
 1909: pp. 746-787. A summary appears on pp. 722-725.
 1910: pp. 1011-1044. Uncorrected page proof. Also published as U. S. Bureau of Fisheries Document No. 749 and in *Fur Trade Review*, December, 1911, and succeeding numbers.

[While these reports are largely of an administrative character, they contain a great deal of information on the censuses of fur seals for the several years mentioned.]

MARSH, M. C.

1911. Report of the census of fur seals in 1906 and other matters. Appendix A, hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 351-371. Comments thereon by Lembkey, pp. 373-375.

PARKER, GEO. H.

1915. The problem of adaptation as illustrated by the fur seals of the Pribilof Islands. *Proceedings, American Philosophical Society*, Vol. LIV, pp. 1-6, 1915.
1917. The fur seals of the Pribilof Islands. *Scientific Monthly*, Vol. IV, pp. 385-409, 1917. [A popular well illustrated account.]
1918. The growth of the Alaska fur-seal herd between 1912 and 1917. *Proceedings National Academy of Sciences*, Vol. IV, pp. 168-174, 1918.

SIMS, E. W.

1911. Report on conditions on the fur-seal islands. Dated August 31, 1906: appendices omitted. Appendix A, hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 378-402. Criticism and comment, pp. 403-434, and on p. 459. [This important document was published separately, but is exceedingly rare. It probably did more to secure the abolishment of pelagic sealing and provide adequate patrol than any other work.]

FOXES.

JUDGE, JAMES.

1909. The blue foxes of the Pribilof Islands. Report of American Breeders' Association, Vol. V, pp. 325-340. Also in *Fur farming in Canada*, by J. Walter Jones, pp. 71-80; published by Commission of Conservation, Ottawa, Canada, 1914. [This article gives an account of the methods of farming blue foxes which were developed by Mr. Judge on St. George Island. The Judge method is the only one which has proved successful with this species and the results now being reaped are a tribute to the zeal of the man who had the courage to overcome the obstacles in his way.]

MERRIAM, C. HART.

1902. Four new Arctic foxes. Proceedings Biological Society of Washington, Vol. XV, pp. 167-172, 1902. On page 171 *Vulpes pribilofensis* is described as new from St. George Island. This is listed as *Alopex pribilofensis* (Merriam) by Miller in his *North American Land Mammals in Bulletin No. 79*, U. S. National Museum, p. 82, 1912.

BIRDS.

EVERMANN, BARTON WARREN.

1913. Eighteen species of birds new to the Pribilof Islands, including four new to North America. *The Auk*, Vol. XXX, No. 1, pp. 15-18, January, 1913.

HANNA, G. DALLAS.

1916. Records of birds new to the Pribilof Islands, including two new to North America. *The Auk*, Vol. XXXIII, No. 4, pp. 401-403, 1916. [Thirteen species new to the islands are here recorded.]
1919. Additions to the avifauna of the Pribilof Islands, Alaska, including species new to North America. *Journal, Washington Academy of Sciences*, Vol. IX, No. 6, p. 176, 1919. [Here appears a list of the new birds for the Pribilof Islands, recorded in greater detail in *The Auk*, Vol. XXXVII, pp. 248-254, 1920. Also see *The Auk*, Vol. XXXIII, p. 443, 1919.]
- 1919a. Check list of birds of the Pribilof Islands, Alaska, with the names of persons first recording the species from the islands. In *Alaska fisheries and fur industries in 1918*, by Ward T. Bower, Appendix VII, Report, U. S. Commissioner of Fisheries, 1918, pp. 105-107.
1920. Additions to the avifauna of the Pribilof Islands, Alaska, including four species new to North America. *The Auk*, Vol. XXXVII, pp. Vol. XXII, pp. 173-175, 1920. [Three species new to the islands are here recorded.]
- 1920a. New and interesting records of Pribilof Islands birds. *The Condor*, Vol. XXII, pp. 173-175, 1920. [Three species new to the island list are here recorded, including one new to North America. Another species is restored to the list, and there is given in tabular form a list of the breeding species on each of the five islands of the group.]
- 1920b. Birds of the Alaska fur-seal islands. *The Gull*, Vol. 2, No. 12, 1920. [Abstract of lecture given before the Audubon Association of the Pacific.]
1921. The Pribilof sandpiper. *The Condor*, Vol. XXIII, pp. 50-57, 1921. [An account of the nesting habits, migrations, etc., with a photograph of the eggs.]

JUDGE, JAMES.

1911. A report on Walrus Island. Appendix A, Hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 907-912. [A detailed account of this wonderful bird rookery and its birds. Additional information on natives' eggging expeditions is given on p. 1180.]

MAILLIARD, JOSEPH, and G. DALLAS HANNA.

1921. New bird records for North America, with notes on the Pribilof Island list. *The Condor*, Vol. XXIII, pp. 93-95, 1921. [Two species new to the Pribilofs are here recorded, and the entire list is corrected up to date, as shown in the notes herewith.]

OBERHOLSER, HARRY C.

1918. Subspecies of *Larus hyperboreus*. *The Auk*, Vol. XXXV, p. 470, 1918. [Two subspecies of the glaucous gull are recorded here from the Pribilofs, one of them for the first time.]

RILEY, J. H.

1917. A bird new to the North American fauna. *The Auk*, Vol. XXXIV, p. 210. [The Kamchatkan pine grosbeak, collected by A. H. Proctor, is here recorded from St. George Island.]

MISCELLANEOUS.

ALLEN, J. A.

1902. The hair seals (family Phocidae) of the North Pacific Ocean and Bering Sea. *Bulletin, American Museum of Natural History*, Vol. 16, pp. 459-499, 1902. [On page 495 is described *Phoca richardii pribilofensis*, a new subspecies from the Pribilof Islands, collected by C. H. Townsend. On page 493 *Phoca richardii* is recorded from the islands, and on page 475 True's record of the ribbon seal *Histiophoca fasciata* is repeated. Allen does not mention the bearded seal (*Erignathus barbatus*) from the Pribilofs; it is known to have been taken on St. George Island on two occasions, however, the first authentic record having been made by C. E. Crompton from a specimen taken in the winter of 1917-18.]

BANKS, NATHAN; HARRISON G. DYAR; TREVOR KINCAID; THEODORE PERGANDE; E. A. SCHWARZ; WILLIAM HARRIS ASHMEAD; and JUSTUS WATSON FOLSOM.

- 1900-1902. A series of papers by the above entomologists appeared in *Proceedings, Washington Academy of Sciences*, Vols. II and IV, recording insects collected by the Harriman Expedition in Alaska. The papers were reprinted verbatim in Vols. VIII and IX of the reports of the Harriman Expedition, published by the Smithsonian Institution in 1910. To them was added a paper on Myriapoda by O. F. Cook in which three species were listed from St. Paul Island, one of them new. [Many Pribilof species of insects are mentioned in the above series of papers and they will be found invaluable to those making a study of the insect life of the islands.]

CARDOT, JULES, and I. THÉRIOT.

- 1900-1902. Mosses of Alaska. *Proceedings, Washington Academy of Sciences*, Vol. IV. A joint paper on mosses collected by the Harriman Expedition.

CHAMBERLAIN, RALPH V.

1921. Linyphiidae of St. Paul Island, Alaska. *Journal, New York Entomological Society*, Vol. XXIX, No. 1, pp. 35-42, Plates III and IV, March, 1921. [A collection of spiders made on St. Paul Island in 1910 by Harold Heath is here described. Eleven species are listed of which six are described as new; four of them represent new genera, which are also described.]

COCKERELL, T. D. A.

1898. New North American insects. *Annals and Magazine of Natural History*, Ser. 7; Vol. II, p. 324, 1898. [On page 324 is described *Bombus kincaidii*, a new species of bumblebee from St. Paul Island, Alaska.]

DALL, WM. H.

1915. A new species of *Modiolaria* from Bering Sea. *The Nautilus*, Vol. XXVIII, No. 138, 1915. [*Musculus phenax* is described as new from specimens collected on kelp roots at St. George Island by G. Dallas Hanna.]

DALL, WM. H.—Continued.

1916. A new species of *Onchidiopsis* from Bering Sea. Proceedings, Academy of Natural Sciences, Philadelphia, 1916, p. 376. [*Onchidiopsis* (*Atlantolimax*) *hannai*, a new sea slug, is described as new from specimens collected on St. Paul Island in 1914 by G. Dallas Hanna.]
1919. Paleontology. Journal, Washington Academy of Sciences, Vol. IX, No. 1, pp. 1-3, 1919. [A list of the fossil mollusks from two deposits on the Pribilof Islands is here given; 44 species are listed, seven of them mentioned as new but only one of which, *Chrysodomus solutus cordatus*, is named. The deposits are located at Tolstoi Points, St. Paul and St. George Islands, and the material was collected by G. Dallas Hanna.]
- 1919a. New shells from the northwest coast. Proceedings, Biological Society of Washington, Vol. 32, pp. 249-252, December, 1919. [On page 251 *Nodulus palmeri* and *Skeneopsis alaskana*, two marine shells, are described as new from material collected by William Palmer and A. G. Whitney on St. Paul Island.]
1920. A new Alaska Chiton. Nautilus, Vol. XXXIV, p. 22, July, 1920. [*Schizoplax multicolor* is described as new from St. Paul Island, Alaska.]

FRANKLIN, HENRY J.

1912. The Bombidae of the New World. Transactions, American Entomological Society, Vol. XXXVIII, Nos. 3-4, 1912. [On p. 295 the description of *Bombus kincaidii* (Cockerell) from St. Paul Island is repeated.]

HANNA, G. DALLAS.

1914. Interesting mammals of the Pribilof Islands. Proceedings, Biological Society of Washington, Vol. XXVII, No. 218, 1914. [Polar bear, walrus, and sperm whale mentioned from St. George Island.]
1919. The introduction of *Acanthinula harpa* (Say) and *Circinaria Vancouverensis* (Lea) into St. Paul Island, Alaska. The Nautilus, Vol. XXXII, p. 143, April, 1919. [An account of the introduction of two land snails from Unalaska is here given.]
- 1919a. Geological notes on the Pribilof Islands with an account of the fossil diatoms. American Journal of Science, Vol. XLVIII, pp. 216-224, 1919.

HARRING, HARRY K.

1917. A revision of the rotatorian genera *Lepadella* and *Lophochasis* with descriptions of new species. Proceedings, U. S. National Museum, Vol. LI, pp. 527-568, 1917. [On p. 550, Plate 92, figs. 13-16, is described *Lepadella borealis*, a new species of rotifer from Ice House Lake, St. Paul Island, collected by Geo. H. Parker in 1914.]

MALLOCH, J. R.

1920. A synoptic revision of the Anthomyiidian genus *Hydrophoria* Robineau-Devoidy (Diptera). Canadian Entomologist, Vol. LII, pp. 253-257, 1920. [On page 257 appears the description of *Hydrophoria alaskensis*, a new species from St. George Island, Alaska, collected by G. Dallas Hanna and on St. Paul Island by the same and Harold Heath.]
1921. A synopsis of the North American species of the genus *Helina* R.-D., Sens. Lat. (Diptera: Anthomyiidae). Ibid., Vol. LIII, No. 5, pp. 103-109, 1921. [*Helina hannai*, a species of Diptera, is described as new from St. George Island, Alaska.]

PEARSE, A. S.

1913. Notes on a small collection of amphipods from the Pribilof Islands, with descriptions of new species. Proceedings, U. S. National Museum, Vol. XLV, pp. 571-573, 1913. [Five species are listed from St. Paul Island, two of which are described as new. They were collected by M. C. Marsh and W. L. Hahn.]

STERKI, V.

1917. A new mollusk of the genus *Pisidium* from Alaska, with field notes by G. Dallas Hanna. Proceedings, U. S. National Museum, Vol. LI, pp. 475-477, figs. 1-2, 1917. [*Pisidium hannai*, a minute fresh-water bivalve shell, is described as new from Ice House Lake, St. Paul Island, collected by G. Dallas Hanna.]

INVESTIGATION OF THE SALMON FISHERIES OF THE YUKON RIVER.

By CHARLES H. GILBERT and HENRY O'MALLEY.

OUTLINE OF PROPOSED INVESTIGATIONS.

An exhaustive investigation of the problems presented by the salmon run of the Yukon River obviously would require practical and scientific inquiry extending over a series of years. During the few summer months no very ambitious program could be attempted. Many of the most important problems must remain untouched. Time would not permit an examination of the tributaries with their spawning beds. No study could be made of spawning habits nor observation of the fate of eggs and fry where these must lie beneath the gravel of the ice-locked streams during the long severe winter and spring. Yet the possible destruction of eggs by freezing may be an important factor in limiting the size of salmon runs in far northern rivers and may, indeed, be responsible for the practical elimination of salmon from the streams that enter the Arctic Ocean. If natural propagation on the Yukon is rendered relatively ineffective because of severe climatic conditions, the operation of hatcheries would here produce proportionately greater results than in more temperate regions. To the extent that natural propagation in any region is wasteful and unproductive do the advantages of artificial propagation appear.

In a single short season it could not be hoped to carry out more than the following program:

1. To inspect the spawning runs as these enter the mouth of the river and to ascertain by microscopic examination of the scales as much as this method can furnish of the life history of the Yukon salmon.

2. To examine the fishery operations carried on by the Carlisle Packing Co., in the Delta of the Yukon, this being the only cannery which packs salmon bound for the spawning beds of the Yukon.

3. To investigate the consumption of fresh and dried salmon by the resident population of the Yukon Valley and to estimate the importance to them of this salmon supply.

4. To draw such conclusions as the facts warrant concerning the magnitude of the Yukon salmon run and its adequacy to support cannery operations in addition to meeting the needs of the local population and providing a sufficient spawning reserve.

ITINERARY.

In carrying out the program above outlined the writers arrived in Skagway on May 12 and crossed White Pass and Lake Lebarge in time to take the first steamer down the Yukon, close behind the running ice of the spring breakup. At Tanana, which was reached May 31, transfer was made to the gasoline launches of the Bureau of

Fisheries, and from June 8 to 13, in company with C. F. Townsend, inspector, Alaska Fisheries Service, the party proceeded by launch to the mouth of the river, arriving June 13 at the entrance to Kwiguk Channel, where was located the floating cannery of the Carlisle Packing Co.

From this date until August 1 attention was given to the fishing grounds located in the Kwikluak mouth of the river and in the off-shore district beyond this mouth, and to the principal channels of the delta which are closed to commercial fishing. From June 25 to July 1 the party proceeded by launch from Kwiguk to Holy Cross and return, to inspect the fishing camps of the lower river during the height of the king-salmon run. From July 5 to 7 a trip was made by launch from Kwiguk to the middle mouth of the Yukon, traversing both the Kwikpak and the Kawanak Passes, returning by way of Old Fort Hamilton, and inspecting en route the run of salmon in these channels. From July 23 to 29 a trip was made by steamer from Kwiguk to St. Michael and return, passing through the Apoon mouth. During the fishing season in the delta careful scrutiny was given daily to the salmon runs, and scale data were secured from extensive series of the different species of salmon which comprise the run.

From August 2 to 20 visits were made to fishing camps along the river from Kwiguk to Rampart, an approximate census secured of the amount of dried salmon, and fishermen interviewed concerning the runs of 1919 and 1920. Having proceeded by steamer from Rampart to Dawson, August 23 to 31, the return was made by launch from Dawson to Tanana, September 1 to 5, visiting on the way the fishing camps of the upper river. This phase of the inquiry terminated at Fairbanks on September 11, after ascending the Tanana River by launch as far as Nenana.

IMPORTANT SPECIES OF SALMON WITH DATA CONCERNING RUNS.

All five of the species of salmon known on the Pacific coast of North America make their appearance at the mouth of the Yukon and ascend that stream for a greater or less distance. Two of these species, however, the humpback salmon and the red or sockeye salmon, are present in such limited numbers as to have no practical significance. The three other species, namely, coho or silver, king, and chum or dog salmon, have substantial runs in the Yukon River, the latter two being of real economic importance.

RED OR SOCKEYE SALMON.

During the entire fishing season of 1920 the Carlisle cannery secured only 5 cases of sockeye salmon, in the neighborhood of 60 fish. As the majority of these were taken on the flats outside the mouth of the river, there might seem warrant to consider them as strays which had wandered from the Kuskokwim, or from some other stream to the southward which possesses a well-marked run of this species. In that case they might not even be entering the river, but playing about for a time in brackish water before finally resorting to their native streams for spawning purposes. In favor

of this theory stands the fact that no breeding ground of the red salmon has yet been reported from any part of the Yukon Basin. The breeding ground of this species could be looked for only in connection with some lake, as the red salmon will not spawn under other than lake conditions. And the males of the species, when on the spawning grounds along the shores of a lake, or in the shallows of the creeks which enter it, are of such brilliant color as invariably to attract attention. It may be, therefore, that no permanent colony of red salmon exists in the Yukon, and that the major portion of the individuals observed off the mouth of the river would not enter and ascend the stream. Occasional individuals do, however, ascend the Yukon, for the writers learned of their infrequent occurrence from observers acquainted with the different species of salmon, and one specimen (a male, decidedly pink in color) was seen at Ruby on August 14. During the much longer fishing season of 1919, 20 cases of red salmon were packed by the cannery.

HUMPBACK SALMON.

The humpbacks appear at the mouth of the river more numerous than the red salmon, but never in sufficient numbers to constitute a run, even of small dimensions. It was noticeable that they were far advanced toward spawning in July, often with liquid milt and partly free eggs. It would be impossible for them to ascend the river far with their spawning period so close at hand. In fact, there were no reports of their occurrence above Andreafski, where a ripe male was observed on August 3.

COHO SALMON.

The least in value of the three principal species is the coho, which runs much less numerous than the other two, and, in addition, is the latest to appear, often not presenting itself in any numbers in the middle and upper reaches of the river until the ice is forming in the fall. This species is little dried on account of its late appearance, but may be fed fresh to the dogs or frozen for later consumption. It seems not to be highly valued for human food.

During the season of 1920 it was entering the mouth of the river in very limited numbers during the last week in July, but nothing approximating a run had at that time developed. The individuals then entering were bright silvery on the sides of the body, without trace of the red coloration which later appears, and the jaws of the male had developed no hook. Later, while inspecting the fishing camps between the mouth of the river and Tanana, from August 2 to 15, everywhere occasional individuals of this species were being taken. At Ruby on August 14 the fish wheels were catching from one to six cohos each day; but at the Ramparts above Tanana on August 20 the species had not yet put in an appearance, nor could anything be learned of its occurrence in the main river above Tanana up to the date of the party's return from Dawson on September 5. The individuals observed below Tanana were running principally along the left (south) limit of the river, and it was reported that their main run was always along the left bank in company with the bright chums ("silver") and such king salmon as run late. To what

extent the early cohos turn into the Tanana it was impossible to determine.

In the lower two or three hundred miles of the river the cohos during the early days of August may maintain the bright silvery coloration with which they enter from salt water, but soon a pinkish tinge appears, which becomes intensified to a bright red before Ruby is reached. At the same time the upper jaw of the male becomes bluntly hooked over the lower jaw, producing the characteristic snub-nosed appearance of this species on the spawning grounds, and the enlarged teeth of the males are soon in evidence. These changes in appearance may have already occurred before entering the river in the case of the latest individuals to enter.

It is most unfortunate that the only name by which the coho salmon is commonly known on the Yukon is "chinook," which is the special name of the king salmon of the Columbia River and is totally inapplicable to the coho. Near the mouth of the Yukon, where the influence of the cannery has been felt, the coho is generally and properly designated as the silver salmon, which is one of the two names by which the species is known in other fishing centers of Alaska. Unfortunately, as will later appear, elsewhere throughout the Yukon the term "silver salmon" is generally but mistakenly applied to an entirely different species. To avoid confusion, therefore, it is suggested that this species be known on the Yukon as the coho, a name by which it is generally known to the trade.

KING SALMON.

The king salmon appears at the river mouth shortly after the ice has run out—in the last week of May or the early days of June. The numbers rapidly increase, the run culminates quickly, and then almost as quickly declines. During the season of 1920 the first king salmon was obtained on June 13, although nets had been set to test the grounds for five days prior to that date. The rapidity with which the run sets in is well shown by the records of the first few days at the cannery. On June 15, 34 king salmon were obtained; on June 16, 175; June 17, 1,639; and on June 18, 5,228, this being the next to the largest take on any day during the season. The largest capture of king salmon in any one day was 6,104 on June 21. In no other day, except the two above mentioned, did the number captured quite reach 4,000. The run may be said to have begun on June 15 and to have culminated within the first week. It continued for some 10 days thereafter at a high level, and then registered unmistakable decline. The average take at the cannery for the best consecutive 16 days of the run was a little more than 3,000 fish per day.

The experience during the previous season, 1919, was very similar as regards the beginning, culmination, and decline of the king salmon run. The fish appeared during the second week in June, ran most abundantly during the following week, continued at a high level for two weeks more, and then rapidly fell off.

The average size of the 1920 king salmon was greater than that of 1919, as is shown by the average number required to make a case in each of the two years. The average number in 1919 was 3.54 to the case, while in 1920 it required but 3.03. The difference was even

greater than is indicated by these figures, for in 1919 comparatively few fish of larger size were taken out for mild curing, while in 1920 there were put up 145 tierces of mild-cured kings, with 800 pounds to the tierce. These were all selected from the larger sizes and would have materially diminished the number required per case if all had been canned.

During the early part of the fishing season the king salmon were silvery in color, without trace of red; the testes are small, hard, and purplish in color; the eggs are always small, not more than half the size when mature. The snout of the males was then so little produced as to give no certain indication of sex. This condition continued during the greater part of June, near the latter end of which the run indicated a decided falling off. But on June 29 a second run appeared of small dimensions, and it was at once apparent that these fish were further along in their development. The jaws of the male were now somewhat prolonged and hooked, and the enlarged teeth had begun to show. They were now reddish in color, and the bellies were so thin that they were little valued for mild-cure purposes. These changes were abrupt and coincided with the sudden increase in the run.

The natural enemies which left traces of their presence on the entering salmon were the white whales, or belugas, and the lamprey eels. Belugas were very much in evidence in the lower river channels during the latter part of the season, the size of their schools increasing as the salmon were running more abundantly. Undoubtedly they were feeding on the salmon, and it is safe to assume that they captured and devoured a very large proportion of those on which they succeeded in closing their jaws. But the number of salmon which appeared on the cannery floor bearing unmistakable tooth marks of the beluga was surprising. The sides were scored lengthwise by widely spaced lines, which usually described a gentle curve, but were occasionally angulated. Evidently these salmon had escaped from the very jaws of their pursuers.

Other marks which attracted universal attention and were usually mistaken for hatchery brands were the scars made by the lamprey eel. This slender eel-shaped animal has an oval sucker-shaped mouth provided with rows of rasping teeth. By means of the sucker mouth it attaches itself to the salmon and may rasp off the skin and even deeper-lying tissues for food. A scar is left which often reproduces with great fidelity the details of the mouth, with its outer fringe of filaments and its inner groups of teeth, which in the scar often give the impression of printed characters.

Such lamprey scars have been occasionally observed in other rivers, but never before in such abundance as on the Yukon. This fact probably stands related to the large lamprey run which is indigenous to this stream. They enter the mouth of the river in the fall after the surface has frozen and run up under the ice, to the under surface of which they often attach themselves when resting. Although the run lasts but few hours at any locality, it is of enormous dimensions and furnishes tons of food to those who dip them up through holes cut in the ice.

Like the salmon, the lampreys enter the river for purposes of propagation, and all die after the eggs are laid. The young soon

after hatching burrow in the mud of the river banks and live like earthworms for an indefinite period of two or more years. After this they pass out to sea when some 6 inches long, and spend the remainder of their life in the ocean. So far as known to the writers, the lamprey scars have been found on salmon exclusively, and on the Yukon never on chums or dog salmon. Some king salmon would have two or even three scars and one was found on a sockeye, but among the thousands of Yukon chums that we inspected there was not one that had been attacked by a lamprey. It is an interesting question whether the Yukon lampreys follow the king salmon of their own river on their feeding grounds and prey on them. It is not known that their attacks are ever dangerous. The salmon observed seemed in no case to have been seriously injured.

That the king salmon ascend the Yukon at a high rate of speed has been accepted generally. An attempt was made to secure reliable records of their first appearance at a large number of localities along the river. Wireless messages were sent to a number of points during the early days of the run before the dates should be forgotten. And, in addition, a number of important records were secured during visits to the fishing camps, some of these giving the catch in detail day by day throughout the season. While it is recognized that the capture of the first salmon of the season at different points along the river may vary within a day or two in relation to the beginning of the run, an examination of the data indicates that this source of error is not serious and that reliable conclusions concerning the rate of travel can be drawn from the table presented. In this table, when two or more records have been obtained from the same locality, the earliest has been selected as giving the first appearance of the king salmon in that portion of the river.

DATE OF CAPTURE OF FIRST KING SALMON AT LOCALITIES ON YUKON RIVER, SEASON OF 1920.

| Locality. | Date. | Approximate distance traveled. |
|---------------------------------------|---------|--------------------------------|
| | | Miles. |
| South mouth of river..... | June 13 | ..... |
| Run basin, south mouth..... | June 15 | ..... |
| Pilot station..... | June 20 | 107 |
| Marshall..... | do. | 144 |
| Russian Mission..... | June 21 | 204 |
| Trucker's fish camp..... | June 23 | 221 |
| Palmer..... | June 22 | 259 |
| Holy Cross..... | June 23 | 279 |
| Halls Rapids, above Anvik..... | June 24 | 346 |
| Camp 51 miles below Kaltag..... | June 27 | 440 |
| Kaltag..... | June 28 | 491 |
| Koyukuk..... | June 29 | 555 |
| Whisper Creek, above London..... | June 27 | 622 |
| Robt..... | do. | 659 |
| Tanana..... | June 28 | 804 |
| Fish Creek, above Rampart Rapids..... | July 3 | 851 |
| Circle..... | July 11 | 1,227 |
| Charlie Creek..... | July 12 | 1,317 |
| Eagle..... | July 13 | 1,402 |
| De Wolf's fish camp..... | July 14 | 1,478 |
| Dawson..... | do. | 1,504 |

Inspection of the above table shows the slowest rate of travel in the first hundred miles of the river above its mouth. From the entrance of the South Mouth to Pilot Station is approximately 130 miles, but it was five days after the run began in the mouth of the river before the first king salmon appeared at Pilot Station, indicating a rate of about 30 miles per day. Between Pilot Station and Tanana, on the other hand, the rate of travel was slightly more than 80 miles per day. This discrepancy is probably due to the habit of playing back and forth in brackish water, on entering the river mouth, before beginning their serious ascent of the river. It is well known to the fishermen at the mouth of the river that salmon enter the gill nets as numerously from the upstream as from the downstream side. They pass back and forth on the tides, lingering within the fishing district, thus giving the nets many more opportunities to capture them than would be the case if they pursued a direct course on entering the stream.

Three records below Tanana, those of the camp 51 miles below Kaltag, Kaltag itself, and Koyukuk, do not align themselves with the remainder of the series. At the average rate of travel king salmon should have reached Kaltag by the 24th instead of the 28th and Koyukuk by the 25th instead of the 29th. In both of these localities the capture of king salmon was considered of little relative importance, and the records are doubtless defective.

Above Tanana the current of the river increases materially, rapids are encountered, and the intricate channels of the Yukon Flats are to be threaded. It is not surprising to find that the rate of travel in the upper portion of the river becomes reduced. Not only are the difficulties of ascent increased but the potential store of energy in the fish approaches exhaustion. When they enter the mouth of the river they are the richest in oil of any salmon known, but by the time they reach Dawson their flesh is comparatively dry and flavorless, the oil having been expended to supply the energy needed in ascending 1,500 miles against the current and in carrying forward at the same time the sexual changes which precede the act of spawning. The average rate of travel from Tanana to Dawson was slightly less than 45 miles per day, while from Pilot Station to Dawson, involving practically the entire length of the river below Dawson, the average rate was 57 miles per day.

No record of any other river approaches this in completeness nor in the high rate of travel indicated. The unexampled speed with which salmon ascend the Yukon is doubtless associated with the great distances to be traversed before reaching their upper spawning areas, taken in connection with the shortness of the northern summer.

Inasmuch as the investigators were compelled to restrict their attention to the main river, they are unable to designate the principal spawning areas of the king salmon. Limited numbers of kings are reported to turn aside into all the principal tributaries of the lower and middle sections of the river, but it is believed that a relatively large proportion of the run passes beyond the mouth of the Porcupine into the upper portion of the basin.

CHUM OR DOG SALMON.

Although the king salmon is an important source of food to the natives and the white population, it is far surpassed in value by the

chum or dog salmon, which must be considered the principal food product of the Yukon River.

It makes its appearance off the mouth of the river only a few days later than the advent of the king salmon. In 1920 the first chum was obtained June 17, and from the 17th to the 19th, 138 became entangled in the coarse mesh of the king salmon nets set outside the mouth of the river; but none apparently had as yet entered the stream. On June 20, 2 were reported inside the river: June 21, 82; and June 22, 26; but during these three days 856 were taken in the outside nets, indicating clearly that the chums were beginning to school in some abundance outside the river, but that few were entering up to June 22, when the run up the river may be said to have begun. It became greatly accelerated on June 29 and maintained itself with minor fluctuations, until the cannery ceased operations the middle of July. No strictly quantitative results concerning the run of chums could be obtained from the cannery records during this season, as nets with appropriate mesh for capture of chums were not employed until the last week in June. For this reason, the apparent increase in size of run during the latter days of June is certainly overemphasized by the cannery statistics.

The first chums to arrive were further advanced toward sexual maturity than were the king salmon. In the latter the testes and ovaries were small and the smout so little produced in the males that there was no certain external evidence of the sex of the individuals examined. But in the case of the chums, even those earliest to run had the milt white in color and obviously enlarged, and the large eggs were already loosening in the ovary. The jaws of the males were not hooked, but were showing a slight sharpening and elongation, so that sex determination could usually be made from the appearance of the head. All the early chums were bright silvery in color, with abundant oil, and pinkish flesh which turned a deeper red on drying. All of them were in such condition that they would have been classed as "silvers" rather than as "dog salmon" by fishermen of the upper river.

But changes in the appearances of the chums were soon apparent. At first, as in the case of the king salmon, rare individuals, usually males, showed themselves in an advanced stage of development, with brightly colored bars on the sides of the body and long hooked jaws. They stood out conspicuously from their fellows, which were still in the "silver" stage.

But by the last of June, when a great increase suddenly occurred in the take of chum salmon, obvious seasonal changes had appeared in this species, as in the king salmon running at the same period. It was now the rule for the males to exhibit elongated jaws provided with canine teeth, and to show the beginnings of the conspicuous color marks which characterize the spawning males of this species. During the first days of July the run of chums again fell off, accompanied by a further increase in the matured appearance of the fish. As this occurred at the same time in chums and in king salmon, it appeared to the fishermen that the end of the run was in sight.

On July 7 a new run of chums suddenly set in, the great majority of which were of bright silvery appearance and with no further seasonal advancement than had been shown by the fish that ran first in June. Among them were a few stragglers of the previous run, the

males and females equally conspicuous among their silvery companions. On subsequent dates these stragglers became more rare, and when the party left for the upriver on August 2 the few chums that were then running were almost wholly of the pronounced silvery type.

It is unfortunate that confusion should have arisen in the Yukon from a failure to recognize that the dog salmon and the so-called "silvers" represent different phases in the development of one and the same species.

The "dog salmon" are the individuals furthest advanced toward spawning. They exhibit the elongated hooked jaws and enlarged teeth in the male, the bright nuptial coloration, and the impoverished condition of the flesh, which is light in color, largely devoid of oil, and possessing very little substance when dried.

In the "silvers" the eggs and milt are less developed, the jaws of the male are little or not at all hooked, the external coloration is silvery, or with a light flush of red, and the meat is red in color when dried, rich in oil, and valuable both for human food and for dogs.

In general, the "dog salmon" along any stretch of the river consist of those individuals which will turn into some adjacent tributary to spawn, while the "silvers" are on their way to the upper reaches of the river, show relatively little of the sexual changes they will exhibit on their spawning beds, and are still richly provided with the oil which serves as fuel and principal source of nourishment during the long journey still before them.

Many fishermen recognize the difficulty of distinguishing sharply between "dogs" and "silvers" and relieve their embarrassment by recognizing a third class, the "half-breeds." But the term "silver salmon" has acquired a fairly definite and useful significance in the trade. "Dog salmon" are so poor in nourishment that they have indifferent value even for dog feed, and will not be purchased except during times of extraordinary scarcity. The natives will feed them to their dogs, but will not eat them themselves unless king salmon and "silver salmon" are unobtainable.

The use of the term "silver salmon" for bright silvery chums, still rich in substance, is so universal and of such long standing in the interior of Alaska that it seems useless to attempt to supplant it with any other name. Confusion will inevitably result owing to the presence of the totally different species, the coho, which is commonly known in outside waters as the silver salmon. It is proposed, therefore, that the term "silvers," when referring to the Yukon basin, be restricted to the chums known commercially by that name, while the three species of salmon of importance on that stream be known as the king, the chum, and the coho.

It became evident, as we were ascending the river in August, that the "dogs" and the "silvers" were in general keeping apart from each other and were following distinct migration routes. Throughout the entire lower course of the Yukon, from Tanana at least as far as Anvik, the "dogs" predominated on the right (north limit) of the river and the "silvers" on the left limit. This is generally recognized by all the fishermen of that region, who also agree that the "dog salmon" turn into all the creeks and smaller tributaries, while the silvers "dislike the taste of fresh water," as a native fisherman stated the case. It is also recognized that a heavier run of kings and

of cohos is found in company with the "silvers" along the left limit of the river. It appears, therefore, that there is a prevailing use of the left shore by those fish which are bound for the upper reaches of the river. This may have connection with the fact that the majority of the tributaries of the lower river enter on the right bank.

The run of chums is not of uniform character and quality throughout the season. Fishermen recognize a succession of phases in the run, characterized by fish which on the average are recognizably different. In general, it is stated that the run of chums which accompany the king salmon are of relatively small size and poor quality, commonly known as dog salmon. Following these is a run of bright fish of good quality but inferior size, known as "silvers," while the last chums to run, late in August and early in September, are the finest of all, the "silvers" par excellence, a bright rich form distinctly of larger size. This last run of "silvers" ordinarily is of short duration, but is frequently of great intensity, and furnishes the most highly prized fish of the season.

As it was necessary to make a canvass of the entire river before the fishing season had come to a close, the writers were unable to observe the alleged succession of forms of the chum salmon at any locality. Distinct differences in the character and quality of the fish appeared at the various camps visited, but these differences were apparently dependent either on the proximity of the camp to important tributaries into which spawning chum salmon would pass, or, more especially, on the location of the camp with reference to the river itself, whether on the right bank or the left. In general when following up the right (north) bank of the river the quality of the fish became poorer as one approached the mouths of the tributaries. The impression was strong that the fish destined for these tributaries were farther advanced than those with which they were associated on the same side of the river bound for more distant spawning grounds. A further more detailed study of the characteristics of the chums at different times and in different localities and the distribution of the various strains to their respective spawning areas would offer results of importance equally from the biological and from the strictly practical point of view. During the season of 1919 the bright chums, or "silvers," were said to be almost wholly wanting. If these were the fish bound for the more distant spawning beds, then the upper sections of the river must have remained largely unseeded in 1919 and incapable of producing their quota of a subsequent season's supply. In 1920 the run of chums was peculiar, in that it lasted longer than is usual in good years, but was of less intensity, and the August run of "silvers" failed to attain its usual proportions. In subsequent years the late run of "silvers" should be carefully noted. If there is evidence of a progressive decline, steps should be taken to protect this most important part of the run. To accomplish this result information should be obtained concerning the spawning beds which are resorted to by this large and valuable race of chums.

The chums travel up the river at a rate approximately equal to that of the king salmon. In 1920, as has been shown, they were schooling on the tide-flats off the mouth of the river nearly a week before they began to ascend the stream in any numbers on June 22. Adopting the latter date as the beginning of the run, it appears that they

started about a week later than the king salmon. In the section of the river between Loudon and Tanana, they were reported as 8 to 10 days behind the kings, and in the district between Circle and Dawson, the first chum was recorded 11 to 17 days later than the first king. It is evident, therefore, that the chum salmon, also, although apparently far less vigorous than the king, ascend the river at an astonishing rate of speed, maintained without cessation for well over a month, under the necessities imposed on them by the short summer and the rigorous fall climate of the Yukon.

The opinion has already been recorded that the king salmon of the Yukon is the richest in oil of any known king salmon. The same statement, made with even greater emphasis, may be advanced regarding the Yukon chums. This species is noted in other localities for its poor oil and poor color. The canned product is the reverse of attractive in color or in richness, and occupies the lowest rank in the markets of the world. In other river basins the chums do not travel far from the sea, but enter late in the season and seek spawning beds not far inland. But the best of the Yukon chums travel 1,000 to 2,000 miles up a river known for its consistently rapid current. They form a rich table fish in the lower section of the Yukon, where the king salmon, to ordinary palates, contains a superabundance of oil. No more striking evidence of the richness of the king salmon can be found than that presented in the smokehouses of natives in the lower river. Here the drying salmon constantly drip a pure, clear red oil, which is collected in vessels and preserved for winter use. At the village of Ohogamute, above Marshall, we observed some 30 quart bottles filled with red salmon oil, secured this season from drying king salmon.

YUKON DELTA, ITS PRINCIPAL CHANNELS, AND ROUTES MAINLY FOLLOWED BY SALMON.

The Yukon River subdivides numerous within its extensive delta, and sends its waters to the sea through a large number of distinct channels. Many of these are narrow winding canals, which meander in every direction interminably through the flat lands, before they attain the outer edge of the delta. Through all of them, doubtless, some salmon pass, but three of the channels so far transcend the others in size and importance that for practical purposes they may be considered as forming the mouths of the Yukon and the main migration routes of the entering salmon. The channels in question, in order of importance, are Kwikluak Pass, or south mouth, with its important branch, the Kwiguk Pass; Kawanak and Kwikpak Passes, which coalesce before entering the sea and form together the middle mouth; and Apoon Pass, or north mouth.

Much the smallest of the three is the Apoon Channel, which traverses the northern sector of the delta, and forms the most direct route for river steamers bound to and from St. Michael. Although exclusively used as a steamer channel, it is poorly adapted for this purpose, being so shallow both within and without the mouth that light-draft boats have quite the habit of going aground there and waiting until a favoring tide shall float them.

Few salmon apparently find their way through Apoon Pass. A few families of natives from Kotlik village had established a fish

camp on the shore just outside the mouth of the river, but the drying frames were scantily supplied with salmon when they were seen in the last week of July. Between the mouth of the pass and old Fort Hamilton no fishing stations were occupied, and the nets operated by the white trader at old Fort Hamilton were having no success. The general belief that Apoon Pass is of little importance as a fishway seemed wholly justified by observations. It has probably no greater importance than have some of the subsidiary channels through the delta.

The lower Kwipak and the Kawanak Passes, which together constitute the middle mouth, are the least known of the three main divisions of the river. No steamers traverse them and very few natives have their summer fishing camps along their banks. The Kawanak is a stream of large size and fair depth of water and the lower Kwipak, although choked with sandbars, carries a considerable current.

This middle mouth was visited July 5 to 7, at a time when the Carlisle Packing Co., on request, was testing the run of salmon by setting nets in the lower Kawanak Channel. Two nets were set along the left bank and two others were set offshore along the edge of a bank. This test was made during a slack period in the run in the south mouth, when the king salmon especially were running in greatly reduced numbers and the chums were not coming in full force. During 14 hours' fishing in the Kawanak Channel the four nets took 3 king salmon and 67 chums. In a second test of equal length the following day the showing was even less favorable.

One native fishing camp, which obviously has been occupied for many years, is located on the upper point of the long island which separates the Kawanak and Kwipak channels, immediately below their first confluence near the mouth. Four families were encamped at this place, and reported a favorable catch of king salmon during the preceding two weeks. The run had now slackened, they said, and the chums were just beginning to appear. They had found the season thus far very much better than the preceding year, when they had fished in the same locality. During the season of 1919 they had been unable to secure many more salmon than they had needed for their summer's use. At the time the camp was visited they had caught enough king salmon to fill one rack and two smokehouses, and had made use of two short gill nets of their own make set in an eddy along the bank of the island. The nets were not more than 25 feet long. Later, when a fresh run had entered the south mouth, word was received that the native fishermen in the middle mouth were again making good catches. It seemed, therefore, that the runs in the two mouths were well synchronized, the fluctuations during different seasons and between different days of the same season, following each other closely. This was well shown in a test made in the middle mouth, on request, during the earlier part of the season, when king salmon were running abundantly in the south mouth. This test was made on June 25 and 26, and resulted in a satisfactory catch of king salmon, with very few chums.

In view of the tests here indicated and observations at the fishing camp, it can not be said that the middle mouth lacks importance as a route for salmon. Yet it is considered to be very far indeed behind the south mouth in this respect. It is doubtful whether it equals in

importance the subsidiary channel known as the Kwiguk, which branches off from the Kwikluak Pass, a few miles above its mouth. It may safely be inferred that the native fish camps are located at the most favorable fishing sites. These are occupied year after year and generation after generation by the same families and their descendants. Where native fishing villages are most thickly grouped will be found the largest and most unfailing supply of salmon. With this as a basis, the writers are compelled to conclude that the south mouth serves as the migration route for the greater part of the Yukon run. While no data are available for an estimate, it is not considered beyond the bounds of probability that nine-tenths of the entire run enter by the Kwikluak Pass and its subsidiary channel, the Kwiguk. About 100 families of natives were fishing in this district in 1920, while not to exceed 10 families were seen in the middle mouth below Dogfish Village. In no case did the latter families have equal success with those camped on the Kwikluak Pass.

It is on the Kwiguk Channel, just below its emergence from the Kwikluak, that the floating cannery of the Carlisle Packing Co. has been located during the two seasons of its operation in the delta. Protected from the heavy southerly winds which blow up the main channel during the summer months, this site is within easy distance of the main fishing grounds in the lower part of the Kwikluak Channel and among the offshore shoals and islands. Inasmuch as the Yukon salmon appear largely to travel along the banks, in the eddies, and along the margins of submerged banks, it is believed possible during a favorable fishing season to secure from this location as a base a very considerable proportion of the salmon of the Kwikluak Channel. Fortunately, no commercial fishing for export is permitted in the Kwiguk Channel. Several native families were located on this channel in 1920, and one white trader maintained a wheel. Good catches of king salmon and chums were secured at all of these camps, but it was believed that the run of kings was proportionally not as heavy as in the main channel.

COMMERCIAL FISHERY OPERATIONS IN YUKON DELTA IN 1920.

The fishery operations of the Carlisle Packing Co. in 1920 were conducted principally in the south or Kwikluak mouth of the river and beyond that mouth among the seaward channels which diverge from it. The mouth of the Kwikluak Channel was designated as it was during the previous season by a stake set in the right or northern bank on the projecting point of land at Ingrakaklak (see U. S. C. & G. S. chart 9373) and by a stake set on the left or southern bank of the channel at the entrance to the well-marked lagoon some half mile below Nilak.

A few fishing camps were established by the company as far up the Kwikluak Channel as Dogfish Village, where the main river makes its first grand division into the Kwikluak Channel and a channel which later divides to reach the middle and the Apoon mouths. Above Dogfish Village no fishing camps were established by the company, but they purchased limited numbers of salmon from a few independent fishermen, who operated at points below the mouth of Clear River near Andreadfski.

Commercial fishing for export was thus carried on exclusively in the main Yukon, between the mouth of Clear River and Dogfish Village and below Dogfish Village, in the main Kwikluak Channel and its seaward extensions. All subsidiary channels branching off from the Kwikluak were closed to commercial fishing, whether these served as communicating links between larger channels, as in the case of Aproka Pass, or, as in the case of the Kwiguk Channel, secured independent egress to the sea.

But in no case were the salmon which entered through these protected channels given unimpeded access to the upper river. All of them must pass through the 40 or 50 mile stretch of the main river between Dogfish Village and Andreafski, where they were exposed to capture for commercial purposes; and those that enter through the important Kwiguk Channel must in addition run the gauntlet of a further 40 miles of river between the Kwiguk entrance and Dogfish Village. During the past season very little commercial fishing was in fact carried on in the stretch of river above Dogfish Village, but this was of choice and not from necessity, for no restrictions are there imposed by existing regulations.

During the season of 1919, 65 per cent of the king salmon and 61 per cent of the smaller fish—chums, cohos, and sockeyes—were taken beyond the mouth of the river, while in 1920 the proportion was even greater, 69 per cent of the king salmon and 68 per cent of the chums being taken outside.

The fishing grounds in 1920 extended much farther away from the river than in 1919. During a part of the season 12 fishing boats were located between 10 and 20 miles outside Nilak, along the shallow banks bordering the Acharon Channel on the mainland side (U. S. C. & G. S. chart 9373). The outermost stations were for a time the most successful, meeting the Yukon salmon well down the coast toward the mouth of Black River. How much farther in the direction of the Kuskokwim the advancing schools may be encountered in numbers adequate to warrant commercial fishing is as yet undetermined. An expedition which they sent down the coast to Cape Romanof testifies to the interest of the Carlisle Packing Co. in this question.

The fishing methods employed by the company in 1920 did not differ from those in use in 1919. Almost their sole dependence was on gill nets, set in convenient lengths in the eddies and on shallow banks along the main channels. For the most part these were set nets or anchored gill nets, with one end made fast to the shore and the outer end anchored. But during the latter end of the season, when the river was no longer at flood, it became possible to fish on shallow banks, which were not available during the height of the king salmon run. Stake nets were then used in larger numbers and would unquestionably have been availed of more extensively throughout the season had the stage of water permitted.

The gill nets used were of two kinds, the king salmon nets of 8 $\frac{1}{2}$ -inch mesh and the nets for chums and other small salmon of 5 $\frac{1}{2}$ -inch mesh. As the company from the beginning of the season contemplated fishing largely, if not exclusively, for the king salmon, only nets of the larger mesh were issued during the height of the king salmon run, which lasted up to the last days of June. After this

date the smaller mesh nets were also issued, but the number of these on hand was not adequate to supply all the fishermen.

Forty-one boats in all were employed in fishing, 34 of these throughout the season, the remainder for varying periods. Four of them were engaged so short a time and obtained so few fish that they may well be omitted from consideration. To each boat was issued 200 fathoms of king salmon net, and subsequently 200 fathoms of the small mesh salmon net, to the extent that this was obtainable.

In addition to the gill nets, renewed attempts were made in 1920 to use fish wheels. Two of these were constructed by the company, but were no sooner placed for fishing than they were put out of commission by the heavy drift which was running during the early days of the fishing season.

In addition to the above, nine wheels were privately owned and operated within the area open to commercial fishing, and the catch of seven of these was sold in whole or in part to the cannery. A very limited number of salmon were obtained from independent fishermen using nets. The number thus purchased from independent operators using wheels or nets amounted to some 7,400 kings and 27,000 chums, out of a total number handled by the cannery of 58,467 kings and 155,655 chums.

The fishing gear operated by the cannery and by private parties occupied only a narrow fringe along the margins of the channels. No attempt was made to fence or block the main channels in any manner, nor could such an attempt at any time be successful.

The employees at the cannery numbered 254. Of these, 122 were brought in from Seattle, including 40 Orientals and 44 fishermen. Of the 132 Alaskans, 40 were employed as fishermen, while 48 were natives, of which the first crew of 25 ceased work in the middle of the season. It was pleasing to learn from the superintendent that the Alaskan fishermen gave a good account of themselves and would hereafter be preferred by the company.

The pack put up by the cannery in 1920 was far less extensive than in the previous year, as is shown by the following table:

PACK OF SALMON BY YUKON CANNERY IN 1919 AND 1920.

| Product. | 1919 | 1920 |
|--------------------------|--------|--------|
| Canned (cases): | | |
| King salmon..... | 28,582 | 15,934 |
| Chums..... | 24,543 | 12,819 |
| Cohos..... | 3,181 | 0 |
| Reds..... | 28 | 5 |
| Mild-cure (tierces)..... | | 145 |

The comparative lack of success in 1920 was due in part to the unfavorable fishing conditions and in part to voluntary shortening of the fishing season. In 1919 fishing was continued until the close of August, but in 1920 only until the middle of July, as the low market price for chums did not warrant the company in continuing to operate after the run of king salmon was over. The season of 1920 was extremely late on the Yukon, and the king salmon entered with a rush, while yet the river was very high and was carrying down enor-

mous quantities of drift, which clogged the nets and rendered them inefficient. Also, during July the weather was unusually stormy, interfering with the fishing and endangering both fishing gear and the lives of the fishermen exposed on the flats beyond the river's mouth. From the cannery standpoint, the season was a failure, redeemed from actual loss—if such indeed was the case—by the extremely high price quoted this year for king salmon. Yet the cannery pack of 28,758 cases fell short only 1,242 cases of the maximum number of salmon which had been designated by the Secretary of Commerce as safely to be spared for commercial purposes from the Yukon River run.

No fish intended for export from Alaska were salted on the Yukon River in 1920.

SUPPLY OF DRIED SALMON PREPARED ON YUKON RIVER IN 1920.

On the voyage down the Yukon from Lower Lebarge to the delta, following close behind the running ice, May 24 to June 13, few indications could be observed of preparation for the fishing season. Here and there a white fisherman was engaged in constructing his fish wheel in time for the short king salmon run, but the native fish camps were unoccupied. Later it was evident that in comparatively few instances did the natives have wheels in the water in time to obtain any considerable number of king salmon.

On the lower river, below Holy Cross or Paimiut, the natives belong to the Innuut stock, and fish much less extensively with wheels than do the Indians of the upper river. They employ for the most part short lengths of homemade gill nets, which they set in eddies behind projecting points of the shore. As favorable localities are found almost exclusively along the high right (north) bank of the lower river, the fishing villages are confined to that side.

Above Holy Cross the use of nets becomes less and less an important factor, and wheels are relied on almost exclusively for the capture of salmon. Rarely was the primitive fish trap or basket or the dip net seen in use. The small fish wheels, which seem to have been introduced on the Tanana River in 1904, have been generally adopted on the upper river by whites and natives alike. They cost about \$50 each, in addition to the labor of building them, and are wonderfully effective when skillfully placed.

In the section of the river between Holy Cross and Rampart little dependence is placed by the natives on the king salmon. There is an early short run, and the natives are traditionally dilatory in making preparations. By the time their wheels are in the water the king salmon run is largely over. It is also true that the king salmon are more difficult to preserve, being larger in size and richer in oil. Those that are put up by the natives are kept largely for their own consumption and for this purpose are most highly prized. Taking the river as a whole, a distinct hardship is imposed on whites and natives alike when the king salmon run is below normal.

Unquestionably, however, the chum furnishes by far the larger share of the dried salmon. Along some stretches of the river almost complete dependence is placed on this species, locally known as the dog salmon and the "silvers." The higher grade of chums, known as "silvers," form the staple dog food throughout the Yukon country.

All the traders handle them and may deal in from 5 to 50 tons in a year. But they refuse to purchase dog salmon except as a last resort. The majority of the natives at the close of the fishing season sell a portion of their salmon supply to the trader with whom they deal, frequently leaving themselves without adequate provision for their families and their dogs. Later in the year they are often compelled to repurchase dried salmon at an advanced price, paying for it with the proceeds of their winter trapping. They are, of course, more or less improvident, as in the case of other primitive peoples. Their sale of salmon in the fall is frequently to liquidate their debts to traders who had extended them credit earlier in the season.

In the section of the main river below Rampart, where salmon are still rich in oil and the rainfall during the summer months is usually heavy, resort is had to smoking the salmon in order to preserve them. There is no commoner sight along the Yukon than the cluster of white tents in some picturesque nook among the hills of the right bank, and with them one or more high, barnlike smokehouses, which emit a faint blue vapor. There will be a fish wheel turning in the current along the rocky shore and a number of open-air racks, more or less protected from the weather, on which the salmon are hung for a time until partially dried and ready to be smoked. The picture is, of course, not complete without the native men, women, and children of the summer camp, nor without the invariable row of dogs closely tethered to stakes driven near the water's edge. Here the dogs fatten on the salmon heads and back bones and other refuse. They scratch out shallow holes to lie in alongside their stakes or burrow deep into the adjacent bank, if one be at hand, to escape the implacable swarm of mosquitoes.

Along the Tanana and the upper Yukon is a region of less rainfall, in which also the salmon have relatively dry meat, which is easily preserved. Here smoking is frequently dispensed with and dependence had entirely on air drying. But, by whatever method prepared, the fish of the upper river, of the Innoko, the Koyukuk, and the Tanana, are of inferior grade, and bring a lower price than do fish imported into these districts from the main river. The best product of all is secured from the Rampart Rapids. Here the "silvers" are said to average larger and fatter than in any other section. It is not improbable that inferior strains of dogs and "silvers" have turned into the lower tributaries, leaving at the rapids almost exclusively high-grade fish bound far up the river.

In the coastal district when salmon are running abundantly trenches are often dug in the soil by natives and hundreds of salmon are thrown in without preparation of any kind. They are then covered with earth and nature is permitted to have her unrestricted way with them. When the contents of these trenches are scooped out at some convenient season, perhaps in midwinter, they are said to make acceptable dog feed and to be not wholly shunned by the natives themselves.

The king salmon intended for their own food is often carefully prepared and stored away by natives of the lower river. When sufficiently dried and smoked, the sides are cut into pieces of convenient size and packed solidly in large baskets made for the purpose of woven grass, or willow roots, or frequently of salmon skins which

are neatly fitted together and sewed with sinew. The dog and "silver" salmon are tied in bundles weighing about 60 pounds and stored away in the caches in this shape. King salmon are also put in bundles on the upper river. Mention has been made of the salmon oil obtained as drippings from king salmon. In addition to this product, the eggs are very generally saved, being closely packed in any convenient receptacle, without special attempt at preservation.

During the early part of the king salmon run, from June 25 to July 1, a launch trip was made from Kwiguk to Holy Cross and return for the purpose of inspecting the condition of the salmon racks and obtaining a clue to the extent of the king salmon run along the river. The run had been on in this district about one week, and all the fish racks along the river contained considerable numbers of king salmon. The opinion was general that the season was opening favorably. It is in the delta and along this stretch of river that fishing is conducted largely with short lengths of gill nets set in eddies, and in this district the run of king salmon is a very important factor in providing the winter's supply of food.

In addition to the native camps, there are numerous fishing stations occupied by white men. Many of these men are married to native women, and some of them are found in native camps, dividing the proceeds with the native families. In such cases we observed commonly that the efficiency of the camp was increased. The white men operating on the largest scale were usually holders of winter mail contracts, which necessitated the use of large numbers of dogs. One such mail carrier keeps some 60 dogs and requires annually for their feed from 12 to 14 tons of dried salmon. As these are exclusively dog or "silver" salmon, the number used is between 15,000 and 20,000.

Other white men take dogs to board during the summer and sell all salmon they are able to put up beyond their own needs. Many of the more intelligent natives now count on doing the same. There is a wide and legitimate demand for dried salmon, for use during the winter season when all travel in the interior of Alaska must be by dog team. As it is impossible to carry enough salmon for a long journey, all "dog mushers" depend on the country they pass through. The road houses maintain a supply for this purpose, the dried salmon taking the place of hay and grain in regions where horses are employed, and being equally indispensable.

During the month of August and the first 10 days of September the Yukon was traversed from the delta to Dawson and the Tanana as far upstream as Nenana, traveling in a launch and calling at the fish camps on the way. The number of families was ascertained as accurately as possible, the number of wheels engaged in fishing, and the total amount of dried salmon prepared for the season. In practically every native camp visited, one or more persons had a sufficient understanding of English to enable them to furnish the required information. In the majority of instances the racks, smoke-houses, and caches were inspected, and finally some facility was acquired in verifying by observation the estimates furnished.

By this method the writers are enabled to present an estimate of the dried salmon prepared on the Yukon in 1920, which is based on

more extended data than any heretofore furnished. That it is an understatement of the amount of salmon actually captured and used on the river is obvious from the following considerations:

1. The lower river was canvassed from the 1st to the 15th of August, and there was a later run of "silvers" of limited extent, of which the figures give no account. A message from Holy Cross, dated September 15, indicated a medium run of "silvers" for some three weeks after that point was passed. The still later run of cohos is also not included in the estimates.

2. No clue could be obtained as to the number of salmon eaten fresh during the season, but this must be a considerable item.

3. None of the tributaries of the Yukon were visited, with the exception of the Tanana below Nenana, yet some of these, like the Innoko, the Koyukuk, the Porcupine, and the Stewart, are important streams. The natives in these regions draw on the rivers for their supply of dried salmon, and the white prospectors and miners out on the creeks may obtain their dog feed from the very spawning beds. To what extent spawning beds are invaded for this purpose is not known, but from reports that have been received it would seem probable the figures may reach dimensions of some local importance.

On the Yukon River, from the mouth to Dawson, 97 native fish camps were observed, each of which contained from 1 to 15 families. Three hundred and seventy families were listed, who were engaged in fishing, but the matter was sometimes obscure and the number of families may have been somewhat greater than this. The natives operated 166 wheels, in addition to the short gill nets of the lower river, which were not enumerated. The dried salmon put up by them amounted approximately to 350 tons, or nearly 1 ton to each known family. Many families had less than this amount, but others compensated for the deficiency by harvests of 3, 4, or even 5 tons. The younger generation gives promise of being more provident than the old. Some of them put up large surplus stocks for sale and carry over fish from one season to the next. There is some apparently well-founded complaint that sufficient care is not always given to curing the salmon, so that in rainy seasons like 1920 large stocks may be offered for sale which are rendered almost worthless by mold and decay. One Japanese fisherman operated a wheel on the river and put up 1,200 pounds.

There were 76 white fishing camps, usually with a single white man in a camp, but in a few instances two white men were working in partnership, or a white man in conjunction with natives. There were 91 white men in all, and they prepared approximately 190 tons of dried fish.

On the Tanana River below Fairbanks there were 24 native fishing camps, operating 24 fish wheels and containing approximately 30 tons of salmon. There were also 26 white fishing camps, with 34 wheels and some 52 tons of salmon.

Altogether, on the Yukon and the Tanana, 301 fish wheels were operated in 1920 and resulted in a take of 622 tons. Of this amount 8 per cent were king salmon and 92 per cent were chums. If an allowance of 100 tons is made for the tributaries not visited and for the later runs on the Yukon which were not seen—and this allowance

is almost certainly inadequate—there would be a total provision of dried salmon for the Yukon and its tributaries in 1920 amounting to 722 tons.

The only previous estimate known, based on a partial canvass of the fishing camps, was that prepared by Messrs. H. J. Christoffers and C. F. Townsend, of the Bureau of Fisheries, in 1918 for the purpose of the Yukon hearing of that year. They enumerated 393 fish wheels and a total product of 650 to 700 tons for the Yukon and Tanana Rivers, exclusive of Yukon Territory. Mr. Volney Richmond, manager of the Northern Commercial Co. stores, basing his estimate on conditions throughout the Yukon Valley, intimately known by him for many years, gave 600 tons as a fair annual provision of dried salmon for the region. It is possible that more salmon were dried in 1920 than would represent a fair average for the river, inasmuch as the previous year had been largely a failure, prices for dried salmon had risen to unheard of figures, and all reserve stocks had been exhausted.

Estimating the average dried king salmon at 5 pounds, and the average chum at $1\frac{1}{3}$ pounds, there were about 23,000 kings and 1,000,000 chums put up on the Yukon in 1920 for local use.

COMPARISON OF 1920 WITH 1919.

At all fish camps visited expressions of opinion were invited as to the relative size of the runs in 1920 and in 1919. The evidence given was overwhelmingly in favor of the run of 1919 being considered one of the worst if not the very worst ever known on the Yukon. Natives and whites all were practically a unit in this belief. Those who believed the cannery was not responsible for the shortage were as well satisfied on the subject of the shortage itself as were those who laid the entire responsibility at the door of the cannery. Those who did put up fairly satisfactory supplies of salmon recognized that they were especially favored in their locations, but thought that the river as a whole was relatively bare of fish.

In the lower section of the river more fish would have been prepared if storms had not broken the wheels and interrupted the fishing. Storms also broke wheels and interrupted fishing along this section of the river in 1920, but racks and smokehouses were not empty of fish. The natives about Nulato and Koyukuk would have made better provision for the winter of 1919 had they fished diligently throughout the season instead of potlatching as they did. They would unquestionably have had more fish, but it is doubtful whether they could have secured enough even had they fished consistently with as much diligence as they ever display. It was impossible to doubt, after interviewing several hundred people distributed along the entire length of the Yukon, that the run of 1919 was phenomenally deficient; and, furthermore, that if this condition should become permanent, or should frequently recur, a very serious condition would arise in the interior of Alaska.

No basis is available for a well-founded estimate of the amount of dried salmon put up in 1919, but we believe that 150 or 200 tons would be an outside estimate for the entire river. The price rose to 25, 30, and 35 cents per pound, with no stocks available even at those prices. Men compelled to travel during the winter experienced

the utmost difficulty in securing substitute dog feed. Fresh meat was used, although this is by no means satisfactory, and deplorable numbers of caribou were slaughtered by natives and others for this purpose. Cereals and bacon were made use of, and stores and trading posts soon found their stocks running low. The natives killed, or permitted to die of starvation, half or more than half of their dogs, and many white men were compelled to adopt the same course. Undoubtedly the best dogs were retained and the least valuable were culled out of the teams. But the general opinion entertained by those best acquainted with the natives and their needs was to the effect that the great reduction in the size of their dog teams was disastrous and the dog shortage was sure to hamper them in their efforts to make a living during the coming winter.

There were no reported cases of starvation or of serious suffering among the natives during the winter of 1919 because of the shortage of salmon, although they might well have occurred in outlying districts if help had not been given by white traders and by others. At Tanana rations were issued from the military post at Fort Gibbon, intended to relieve distress among the sick and aged natives of that vicinity. But the winter was in some respects unusually favorable. On the upper river heavy snows drove the caribou to the lowlands near the river, where natives could hunt them without making long sledge journeys with their dog teams into the mountains. Commissioner Mackenzie at Dawson said that had it not been for this fortunate coincidence the Indians in that vicinity would have suffered severely. In the Tanana-Fairbanks district moose were abundant and were easily captured in the deep snows. And farther down the river, in the Nulato-Koyukuk region, the grouse, which had been scarce for a number of years, had begun to come back in their former abundance. Here again had the season not been unusually favorable for securing fresh meat near at hand severe suffering would have been experienced. Such favorable conditions can not be expected to recur should the salmon supply again fail.

To resume, it does not admit of doubt that there was a most serious scarcity of salmon last winter, nor that this was occasioned primarily by an equally serious shortage in the run. By no other theory can so general a failure in the river fishing be explained. The lower and middle sections of the river, the Ramparts and Upper Yukon, the Porcupine, the Tanana, and the Koyukuk, all tell the same story. Dogs were sacrificed in large numbers, which were neither useless nor superfluous, and the natives were saved from serious suffering only by a series of happy coincidences, which could not again be expected.

TO WHAT EXTENT WAS YUKON CANNERY RESPONSIBLE FOR 1919 SHORTAGE?

As the cannery of the Carlisle Packing Co. at the mouth of the Yukon did not operate prior to 1917, and as neither the king, chum, nor coho salmon matures in two-year cycles, it is evident that the cannery could have had no influence on the size of the run which presented itself at the mouth of the river in 1919 and sought access to the spawning beds. The individuals which comprised this run

had all been derived from eggs deposited in the Yukon gravels before ever the cannery was established. There could be no question, therefore of impairment of the run having resulted in 1919 from previous cannery operations.

The only possible effect of the Carlisle cannery up to the present time has been to diminish, by the number of salmon captured, the runs which enter the river and are available to the native and white inhabitants of the valley. In 1919 the company reported the capture of 101,107 king salmon and 357,081 small salmon, largely chums. If these had been captured upriver and dried, the king salmon would then have averaged about 5 pounds each and the chums $1\frac{1}{4}$ to $1\frac{1}{2}$ pounds. Adopting the lower figure, the cannery pack, dried, would have amounted to 252 tons of king salmon and 223 tons of the smaller varieties, or 475 tons altogether. This is held to be more than twice any possible estimate of the amount of dried salmon actually put up during that season on the entire river.

If the 100,000 kings and the 350,000 chums taken by the cannery had been permitted to ascend the river, to what extent, we may ask, would the situation have been helped? It would depend on the size of the run and the proportion which, under the conditions of 1919, would escape capture at the hands of the river fishermen. If the fishing camps along the river were catching 50 per cent of the run, the cannery fish would have added some 235 tons, and the catch would thus have been more than doubled. If they were capturing a third of the run, the cannery fish would have increased their small catch by over 150 tons.

Data for such an estimate are not available. In the muddy waters of the Yukon the schools of salmon are invisible, and no direct estimate can be formed of their numbers. There is abundant evidence, however, that a large majority of the king salmon running in 1919 were captured in nets or encountered nets and escaped from them on the way into the river. White fishermen and natives, practically without exception, including those who felt no hostility to the cannery, agreed that the king salmon averaged smaller in size than ever before and that the relatively few larger individuals were net marked in the majority of cases. The same fishermen, operating in the same localities in 1920, state almost without exception that the king salmon in 1920 averaged large in size, and the number of net-marked fish was so small as to be negligible.

Many opportunities have occurred to observe elsewhere salmon caught in wheels or traps above a district heavily fished with gill nets. The results are always the same. The smaller salmon filter through the nets, which screen out the larger sizes, leaving the average size of the escaping fish always greatly diminished. And many of the fish escape through the web after being temporarily captured, the twine having become so tightly constricted about the body as to leave permanent marks that can not be mistaken. At the rack which was maintained in Wood River above the Nushagak fishing district there was opportunity to examine the fish escaping from gill nets that were capturing from 75 to 90 per cent of the running fish, but never were the escaping sockeyes so extensively net marked as the Yukon king salmon are credibly reported to have been in 1919.

Not all the screening out of the larger sizes and the net marking was due to the operations of the cannery. Natives in the lower river also fish for king salmon with nets, but the extent of their operations is so very small compared with that of the cannery in 1919 that the effect was negligible. Fishermen interviewed stated that they had in previous years seen a few net-marked fish prior to the opening of the cannery, but never anything to compare with the condition observed in 1919. The prevalence of small-sized king salmon in 1919, taken in connection with the extent of the net marking, may justly be considered a measure of the closeness with which these salmon were fished in 1919.

What was true of the king salmon was true also, it is believed, of the run of chums. Fishing for these was prosecuted during the months of June, July, and August. Conditions at the mouth of the river were comparatively favorable for a maximum catch throughout the season. As the salmon move back and forth with the tides, passing up and down the banks where nets are staked, and loitering in the eddies where other nets are anchored, the cannery gear has repeated chances to ensnare them. One of the principal deficiencies in the 1919 run in the upper river was the almost total failure of the "silvers." These, it will be recalled, are the bright chums of high quality which run after the king salmon have passed. It was to these that the cannery devoted its attention after the king salmon nets had been retired. In 1919 the king salmon run had materially declined by July 5, and it was after this date that 272,717 out of the total 357,081 small salmon (principally chums) were taken. It is considered certain that the operations of the cannery in 1919 very materially added to the scarcity of fish on the river. Had the fish captured by the cannery been free to enter the river, the run would still have been below the normal size, but the distress and inconvenience occasioned to the interior of Alaska by the salmon shortage would have been largely mitigated.

EFFECT OF CANNERY IN 1920.

The run of 1920 has been universally approved by fishermen as the most favorable since 1916. Salmon were abundant, of good average size, and of excellent quality. Some fishermen acclaimed it the largest run they had ever seen on the river, but the majority called it a fair average run of the better class of years. Certain it was there was no necessary lack of dried salmon anywhere on the main river as far upstream as Dawson. Some complaint was heard of insufficient fish supply on the Yukon Flats in the vicinity of Fort Yukon, and it was noted in certain native villages between Circle and Forty-Mile that scant provision seemed to have been made for the winter. But it was not evident that there was any lack of salmon. All white fishermen and some natives in these districts made good catches and reported the fish abundant. At Dawson, where serious complaints were heard the previous year, sufficient supplies were secured in 1920. Such slackness as apparently existed in certain native camps may find its explanation perhaps partly in the effects of the "flu," which ravaged some of these communities in the spring of the year, partly in superabundance of money, owing to high prices received for muskrat pelts, and partly, in some com-

munities, to a general shiftlessness, which habitually leads to privation and suffering in the winter.

A similar condition was observed in certain fish camps on the lower Tanana, in which natives seemed obviously less intelligent and less efficient than in the great majority of camps on the main river. In a few of these was heard the complaint that there were no fish, but it is believed that their scant supply was due to other causes. It is of course true that any scarcity will first declare itself on the upper river and among the tributaries, after the salmon, which run in a single channel in the main river, have distributed themselves over a far wider area. It is regretted that reliable reports could not be obtained from the Innoko, the Koyukuk, and the Porcupine.

In comparing the effects of the cannery in 1920 with those in 1919 conditions are met in the two years that were the very reverse of one another.

In 1919 the total run of salmon was far below normal, the conditions for fishing at the mouth of the river were favorable, the cannery catch was very large, and considered in relation to the number of salmon running it was far larger.

In 1920 there was at least a fair average run of the better class, and not improbably it was one of the best runs that can be expected in the Yukon; but the cannery was unsuccessful, owing to adverse fishing conditions. It obtained little more than half as many kings as in 1919 and less than half as many chums. Had the 58,000 kings and 155,000 chums been permitted to enter the river more salmon undoubtedly would have reached the spawning grounds, but the amount of dried salmon would not have been greatly increased. In the first place the number released would bear a small ratio to the total number running in so good a year; and, furthermore, along that section of the river which put up by far the larger amount of dried salmon, wheels, if operated more than a few hours each day during the height of the run, caught more fish than could be cleaned and prepared for drying. It does not then appear that with a large run of salmon and a relatively small cannery pack the latter has any recognizable effect in lessening the dried salmon supply of the Yukon. We are not prepared, however, to venture the assertion that such would have been the case had the cannery pack in 1920 reached as large proportions as it attained in 1919. But even had the cannery put up the full 60,000 cases in 1920, for which it made preparations, it would not have reproduced the severe conditions which existed on the river in 1919. These, as has been shown, were the result of a phenomenally poor season, made much worse by a large cannery pack.

GENERAL DISCUSSION AND RECOMMENDATIONS.

The dependence of the native and white population on the salmon supply of the Yukon admits of no question in the minds of any who have acquaintance with the conditions of life in the great interior of Alaska. The natives have other sources of food, but the salmon form their main provision for the winter—their insurance against starvation when other sources of food fail them, as they not infrequently do. No one who inquires into the matter can doubt that if

the supply of Yukon salmon should become seriously curtailed widespread suffering and death would in many seasons be visited on the natives.

The question of furnishing food for the whites is less urgent, but is not without importance. It was brought to our attention that with the price of all articles of food rapidly rising, while wages in the interior of Alaska have shown practically no increase during recent years, the presence of a cheap source of food is of value.

But one of the most important phases of the salmon question, which concerns whites and natives alike, is in relation to the dog. The whole scheme of things in the sparsely populated Yukon wilderness is predicated on the dog, and the use of the dog necessitates dried salmon. The winter is the only time for travel except along the waterways of Alaska, and winter travel is impossible without the dog team. Dogs are equally indispensable as draft animals and pack animals. Transportation of the winter mails over thousands of miles of the interior of Alaska must be accomplished by dog team. Men of the Army and the Signal Corps, like all other people in Alaska, are dependent on the dog whenever business makes it necessary for them to undertake winter travel. Fort Gibbon alone needs 40 tons of dried salmon each year to feed the dogs that they find indispensable in their work. Prospectors need them to carry their supplies into the hills. Wood choppers require them to haul in the wood. Indians must have them on their long hunting and trapping expeditions, and without them can neither secure meat for their families nor furs to exchange for the other necessities of life.

The dog is as essential in Alaska as is the horse in other regions, and the only acceptable dog feed is dried salmon. Various substitutes have been tried out when salmon could not be procured. They were used extensively by the "dog-mushers" of 1919, when dried salmon often could not be had at any price. Fresh meat was used, and enormous numbers of caribou and moose were slaughtered for this purpose. But it is impossible to carry sufficient meat for many days, and the supply is precarious. Furthermore, the dogs do not thrive and work well on this diet. A diet of cereals and fat in some form was extensively used. Stocks of rice, flour, corn meal, and bacon were heavily drawn on. Dogs traveled well on a ration of corn meal and bacon, but the expense was almost prohibitive, and there was the labor of cooking up each night in camp a meal for the dogs after the exhausting travel of the day with the temperature perhaps 50° below zero and a weary famished team waiting to be fed. Dried salmon forms a light condensed food which contains all the elements needed to keep a hard-working team in excellent condition, and it is always ready to be fed without preparation. There is no acceptable substitute, and there is not in Alaska any divergence of opinion on this subject. No single need in the interior of Alaska is more generally or more urgently felt than dried salmon for its various uses.

It is clear, then, that the Yukon and the Kuskokwim offer salmon problems which are not pressing on any other Alaskan rivers with the exception of the Copper River. These streams drain the far northern interior districts of Alaska with long severe winters and the briefest of summers. The inhabitants are few in number and are distributed widely over a wilderness which is largely without

population. Their lives are subject to the most severe conditions of existence. Largely they are dependent on the resources of the country. To deprive these people of one of their most valued and most important resources would seem under such circumstances peculiarly indefensible. The principle should be adopted with regard to the interior rivers of Alaska that no commercial interests should be permitted to exploit them until it should be demonstrated that a portion of their salmon run could be spared without detriment to the run itself and without encroaching on the supply needed by the populations that inhabit the valleys of these rivers. And if there is any question whether the salmon run in a given stream is adequate to supply the demands of commercial operations as well as the needs of the inhabitants, the doubt should at once be resolved in favor of the people. The subject should not be one for experiment. Canneries should not be permitted to establish themselves on these streams while we calmly await the result. They may create havoc before the evidence thereof is clearly shown, and in the meantime they will have secured those highly prized "vested rights" which make their position difficult of attack.

A floating cannery operated by the Carlisle Packing Co. is already established at the mouth of the Yukon, and it becomes appropriate to inquire whether the continued operation of this cannery is compatible with the best interests of the Yukon Valley. It is evident that if the fish required by this company can without question be safely spared, the cannery should be welcomed, for it provides much needed freight for a transportation company that supplies the Yukon and it offers much needed employment for a limited number of natives and others during a brief period of the summer. But if the operation of the cannery should threaten encroachment on the supply of salmon needed in the interior it should be compelled to close, as no advantage to its few employees could possibly compensate for widespread inconvenience, distress, and suffering.

As a result of the Yukon hearing, given in Seattle, Wash., November 20, 1918, the Secretary of Commerce promulgated an order that limited the pack of canned salmon to 30,000 cases in any year from the Yukon River, embracing all waters of its delta to and including the area 500 yards outside each mouth or slough of the delta at mean high tide. Beyond this area of 500 yards outside the mouth or mouths of the river the Secretary of Commerce exercises no jurisdiction, the Congress having failed to confer it upon him. He is therefore helpless to extend protection to channels between shoals and islands off the mouth of any river, although such channels may be regular migration routes of the salmon bound for that river and as much open to attack as any part of the river channels.

Realizing this deficiency of the laws, the Carlisle Packing Co. in 1919 put up approximately the maximum pack inside the river, and then proceeded nearly to double this with salmon equally bound for the Yukon which they captured outside the mouth of the river. In doing this they were wholly within their legal rights, but they evinced thereby an indifference to the obvious purport of the order, which was to provide for a strictly limited pack of Yukon fish. In making this increased pack they happened on a year when the run was poor and the fishing conditions were excellent. They were

enabled, therefore, to give a demonstration of the results of such operations when these two conditions appear in conjunction. The disastrous year of 1919 resulted.

As to the future, there is no assurance of better protection than in 1919. From our inquiries it appears that the Yukon runs of salmon are by no means uniform in size. Good years and poor years alternate, and occasional very poor years have always appeared. Meanwhile the Carlisle company continues to operate without check beyond the mouth of the river. Should they consider the prospect of success warranted the expenditure, there is nothing to prevent their increasing the number of fishermen and preparing for a pack of 100,000 instead of 60,000 cases. Or one or more other companies may join in the business of catching Yukon salmon off the mouth of the river if they consider the venture a promising one. The Yukon run is wholly without adequate protection as long as the approaches to the river are open to unrestricted fishing and are outside the jurisdiction of the Secretary of Commerce.

Finally, it is the judgment of the writers that the Yukon River salmon run is not to be relied on annually to produce a surplus for export in addition to the supply needed for local requirements and the further quantity essential for propagation. During good years a surplus might be spared sufficient to produce a limited pack, but during poor years the operation of a cannery will have the effect of making a bad situation very decidedly worse.

It is recommended, therefore, that all commercial fishing for export be prohibited in the Yukon River and its tributaries, including the waters of the delta and an area 500 yards outside the mouth of each channel or slough of the delta.

Furthermore, it is recommended that immediate steps be taken to have brought within the jurisdiction of the Secretary of Commerce all those channels between the shoals and islands which form the approaches to the Yukon in order that commercial fishing in said channels for export may be effectively limited or entirely prohibited.



DANGER TO FISHERIES FROM OIL AND TAR POLLUTION OF WATERS.¹

By J. S. GUTSELL,
Scientific Assistant, U. S. Bureau of Fisheries.

Recently the casting of oil on already sorely troubled waters has increased at such a rate, has been accused as the source of so many ills of fishermen and shell fishermen and even of ornithologists, and has become such an obvious nuisance, that a considerable realization of the extent of the contamination and a sense of the possible evil effects have been aroused. So great is the discharge of oils of various sorts that in this country it has been proposed to skim off the oil from some harbor waters and make it available by proper treatment. In Switzerland a patent has been taken out for the recovery of oils from backwaters. It is very desirable, therefore, to present a brief review of the information available regarding the extent and nature of oil and oil-like pollutions with consideration of the possibilities of danger therefrom.

SOURCES OF POLLUTION.

Danger of fatal contamination from the poisonous substances seems to lie chiefly in the gas plants and petroleum distilleries, which on one occasion or another, if not regularly, find it convenient to let certain products drain into the nearest body of water; in tankers and oil-engined craft, which are able to use tar, tar oils, and a great variety of petroleum distillates; in oil-burning steamships; and in the washings of oils and tars from roads.

Gas houses and oil refineries are located on all sorts of bodies of water larger than brooks. In smaller streams, and particularly in those inhabited by salmonids, discharges are doubtless frequently fatal to fish life and quite ruinous to the fish value of the water. In larger bodies the actual destruction of fish is apt to be small or incident to exceptional discharges, and the chief harm probably will come from the uninhabitability of the water, especially if this means the rendering unfit of a spawning ground or the forming of a barrier thereto as for salmon or shad.

In streams large enough for steamers, and in all larger bodies of water, there are added to the contributions from gas houses and refineries those from tankers and other ships, and the dangers to fishes from poisoning or coating of gills are correspondingly increased. These larger navigable bodies may be spawning grounds and are almost sure to be gateways to what should be spawning grounds. The danger here, therefore, of keeping fish away from the spawning

¹ Appendix VII to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 910.

grounds is far greater than the danger of destruction. It has been charged, but apparently not specifically established, that fish in harbors and the lower stretches of rivers have been killed by the dumping of oil from tankers. All of these vessels must clean out their tanks before they refill them and are prone to do so in harbor or as near there as may be.

Well out at sea and in the larger bays the only source of considerable oil pollution seems to lie in the shipping, which, if it can not discharge in or near harbors, will do so at sea. Moreover, it seems clearly established that great oil films do form at sea. Huge patches have frequently been observed, and Collinge reports that sea birds have been found dead and dying by hundreds off the English coast, their feathers saturated with oil. Death of sea birds from the same cause is reported from our Pacific coast.

Tar from freshly tarred roads may be washed bodily into gutters and thence into streams or other bodies of water. Apparently, however, the greatest danger of direct action from tarred roads is from the fact that under the various influences at work—presumably heat, the mechanical action of vehicles, and soluble action of oils—poisonous substances are yielded to road washings for a great length of time. Various people in England, as recorded especially in the (London) Fishing Gazette, have described instances or experiments which indicate the continued poisonous action of tarred roads. Richmond found that although an undisturbed tarred surface became innocuous in three weeks, washings from material chipped from a road which had not been tarred for approximately one year were fatal to fish. Tarred road washings appear to be noticeably destructive of fish and, largely through the destruction of food organisms, of fisheries, chiefly, in streams not larger than small rivers and ponds, particularly trout waters. In well-developed country so fortunate as to possess salmon streams, tarred roads doubtless constitute a menace to the salmon fishery.

Oil from motor cars, etc., goes into small as well as large bodies of water and is of greatest volume at large towns.

EFFECTS OF OIL POLLUTION.

Oil remains in part as a surface film on the water, and is probably in part emulsified and distributed in intermediate strata, while the heavier fractions are deposited on the bottom, where they persist for a long time. All parts are washed ashore to be deposited on the beaches and vegetation between tide marks.

This pollution may affect the fisheries in various ways: By actually killing or repelling the fish when they approach the shores in their migrations, at the only time when they can be caught; by sickening or killing bottom-dwelling species such as oysters; by killing floating eggs and the delicate larvæ which, swimming at or near the surface, are suffocated by the deposit of an impervious film on the gill surface; by destroying the minute surface plants and animals on which these larvæ and some of the adult fishes subsist; by diminishing the aeration of the water at the surface and thereby aggravating the deoxidizing effects of organic pollutions from municipal sewage and similar sources; by destroying spawning grounds; by killing the

shallow water vegetation which directly or indirectly furnishes fish food and shelter; and by impairment of the market value of fish through imparting to them an offensive taste.

DIRECT TOXIC EFFECTS.

A great variety of tars and tar oils, either from coal or petroleum, have been shown to be highly poisonous. Butterfield and writers in the (London) Fishing Gazette and the Salmon and Trout Magazine, and Shelford and Thomas in this country (see bibliography) have reported various experiments which show that tar and tar oils are poisonous in great dilutions. Tars or tar oils result from distillations of coal, petroleum, woods, etc. These distillation products are very complex and varying in composition, but all may be assumed to contain some of the substances which, in very weak dilutions, have been shown to be highly poisonous to various fishes. Phenols and cresols (in dilutions of less than 100 parts per million) have been found quickly fatal by Butterfield and Shelford. Other constituents which are quickly fatal in the dilutions indicated are phenanthrene and naphthalene (4 to 5 parts per million); xylene, toluene, benzene, and ethylene (22 to 65 parts per million); sulphur compounds, as hydrogen sulphide (5 parts per million), sulphur dioxide (16 parts per million); carbon bisulphide (100 parts per million); thiophene (27 parts per million); ammonia (7 parts per million); and ammonium salts and other nitrogenized compounds (some hundred parts per million); quinoline and isoquinoline (50 to 65 parts per million). The strengths given as quickly fatal are those which have caused death in one hour, or very little more, to sunfish (American) or gudgeon (European), fish which seem more than ordinarily resistant to poisons. It is stated (Seydel) that Russian investigators find hexahydrobenzoic acid ($C_6H_{11}CO.CH_2$), to be the essential poison of Russian petroleum, and that 4 to 16 parts per million were quickly fatal to a cyprinid and a percid.

The experiments of Thomas and others indicate that prolonged exposure to very much greater dilutions of these substances are fatal. Dilutions of various tars and crude distillates of petroleum, which required 66 or more parts per million for quick fatality, have proved fatal in strengths of from 13 to 33 parts per million in from 1 to 3 days. A great variety at 13 parts per million proved fatal in 3 days. One liquid tar waste at 2 parts per million killed sunfish (*Lepomis humilis*) in one day.

MECHANICAL EFFECTS.

Certain petroleum products appear to contain no poisonous substances soluble in water and to have little direct effect when allowed to form a surface film, but when emulsified by agitation prove deadly. A high-boiling petroleum distillate and a light fuel oil were found by Thomas to be quite harmless, unless as aeration retarders, or unless emulsified, as by continued moderate agitation, when they coated the gill membranes of the fish and caused death by suffocation. Rushton found that by shaking up 1 part of kerosene with 40,000 parts of water, a mixture was formed which killed fish in five minutes, apparently entirely from poisonous action.

Doubtless under the agitation of continued wave action many, if not all, oils and oily substances will emulsify or mix to a considerable extent and so coat the gills of fish or other forms, or have a poisonous effect which their insolubility would otherwise prevent. According to Weigelt, ulcerations and attacks of disease have been found to follow the irritating action of petroleum products.

The eggs of sea fishes which do not seek fresh, brackish, or shore waters in which to spawn differ from the eggs of all these and of fresh-water species in that they are typically floating. In many cases, at least, the larvæ for a time are also floating. This fact renders the possibility of grave danger to the great sea fisheries a very striking one, for it can scarcely be thought that eggs can hatch and young normally develop in a medium of oil. The eggs and larvæ of oysters and other shellfish are not surface floating, but are carried up and down by the current, sometimes to the surface. A special danger to them lies in the fact that both oil and larvæ (and eggs) are prone to collect in eddies.

PREVENTION OF AERATION OF THE WATER.

The question of aeration prevention by an oil film is a very important one. Butterfield and Thomas have questioned considerable prevention, Butterfield on the supposition that mineral oil is similar to water in its oxygen absorption, and Thomas apparently on the theory that incomplete rather than complete films tend to form. There need be no question that extensive films do form. Furthermore it seems established by Adeney, especially in salt water and any water of considerable mineral content, that streaming, with the consequent distribution of the air saturated surface water, is largely dependent upon evaporation and increased density at the surface. If this is the case it must follow that an oil film, by preventing evaporation, greatly checks aeration. Danger from this seems chiefly to center in harbors where, because of general pollution, particularly sewage pollution, the oxygen consumption is greatest and where, because of gas plants and shipping and the great number of automobiles, the discharge of oil is also extreme. These are the same harbors which are the gateways to the great natural spawning areas of the anadromous fishes.

In connection with the prevention of aeration, oxygen loss by the absorption of dissolved oxygen, by fatty acids and other substances present in oils and tars, should be taken into consideration.

DESTRUCTION OF FISH FOOD.

Indirect action of oils and tars may consist of poisonous action on food organisms. Prawns appear very susceptible to tar poisons, and in English streams it has appeared that tarred road washings are even more destructive of insect life than of trout directly. It can scarcely be doubted that the susceptibility of minute forms is at least of the same order as that of fish. With a number of microscopic forms, particularly diatoms, it is known that their susceptibility to a number of poisons is greater than that of fish (Whipple, Moore, and Kellerman). Destruction may, of course, be secondary,

as from lack of oxygen, or from the destruction or spoiling of emergent or littoral vegetation with an oil coating, particularly in tidal areas (by which means wild fowls may also greatly suffer), and the consequent loss of a productive habitat.

From gas houses, tarred roads, and refineries much of the contamination eventually finds its way to the bottom to render it more or less sterile according to thickness and completeness of the deposit and the constancy with which the deposit is maintained. Wadham indicates that he found apparently complete strata for each fresh tarring of road, and that it took two or more years for a trout brook to recover proper productivity of fish.

In some waters the basic fish food consists in part of air-breathing larvæ and pupæ of insects, which, if a layer of oil is present, as is well known, will be unable to come to the surface to breathe and so will be destroyed. Young of food fishes or the small fish on which food fishes feed will in consequence be deprived of an important source of food, and the productivity of the region will be correspondingly decreased. In 1920, through the Gulf States, Mr. Hildebrand found that *Gambusia* and *Fundulus*, which feed largely on such larvæ and pupæ, disappeared from oil-covered water. He took no special notes in regard to larger species, but believed they disappeared also, presumably because their food had disappeared.

SUMMARY.

Three main sources of oil and tar pollution have been found: Road washings, carrying great quantities of lubricating oil; gas houses and oil refineries; tankers, oil burners, and oil-engined shipping. Tars, tar oils, and crude distillery products are found generally to be highly poisonous, whether in weak or great dilution. Some oils have been found to emulsify to a sufficient degree, with continued agitation, to coat the gills of fish and so produce death by suffocation. An oil film, through prevention or checking of aeration, is dangerous, particularly in busy harbors. The deleterious effect on spawning, by rendering spawning grounds unfit or inaccessible, is a grave danger arising from the pollution of harbors and streams. Another serious danger is found to lie in the possible effects on the diminution of the food supply. Through whatever means, it is an observed fact, according to Weigelt, that in Germany fish have completely disappeared from pools and ponds following the discharge of mineral oil into the water. In the sea a great danger is suggested by the fact that the eggs of sea fishes are typically floating, and that oil-burning and oil-engined shipping is greatly increasing.

Remedial measures may (now or in the future) be found: (1) In the recovery of oils from drainage water, as already has been proposed; (2) in the prevention of gas-house and refinery pollution, which prevention should be helped by the increased use of "wastes" in by-products; and (3) in prevention, by international arrangements, of the dumping of oil from ships in harbors or in the region of spawning grounds or special feeding areas.

BIBLIOGRAPHY.

- ADENEY, W. E.
1912. Report of W. E. Adeney. *In* Present sanitary condition of New York harbor and the degree of cleanness which is necessary and sufficient for the water. Report of the Metropolitan Sewerage Commission of New York, 1912, p. 80-121. Wynkoop Hallenbeck Crawford Co., New York.
- ALLEN, E. J.
1914. Letter telling of deadly effects on swimming prawn of creosote oil in great dilutions. *In* Net curing by creosote. *Fish Trades Gazette*, Vol. 31, Feb. 28, 1914, p. 36. London.
- BUTTERFIELD, W. J. A.
1912. The relation of modern road surfacing to fish life. *The Surveyor*, Vol. 41, Feb. 16, 1912, p. 277-284. London.
- COKER, R. E.
1920. Progress in biological inquiries. Report of the Division of Scientific Inquiry for the fiscal year 1920. Appendix II, Report, U. S. Commissioner of Fisheries for 1920. Bureau of Fisheries Doc. No. 896. p. 23. Washington.
- COLLINGS, WALTER E.
1921. The effects of oil from ships on certain sea birds. *Nature*, Vol. 106, Feb. 24, 1921, p. 830. London.
- FISHING GAZETTE (THE). LONDON.
1910. Note by editor, R. B. Marston, containing letter from R. C. W. H. Butler telling of harmless leakage of a barrel of crude tar into trout ponds. *The Fishing Gazette*, Vol. LX, June 4, 1910, p. 508.
Note by editor quoting letter from Arthur J. Belcher (extracted from the *Daily Mail* of June 14) telling of the immediate destruction of hundreds of trout following the washing of tar from a freshly tarred road into trout brook. *Ibid.*, Vol. LX, June 18, 1910, p. 559.
Letter from A. R. Peart telling of experiments showing deadliness to fish life of water which has been in contact with fresh crude tar; also pointing out that road washings may be expected to reach stream while it is still shrunken by preceding drought. *Ibid.*, Vol. LX, June 25, p. 607.
Account by Field of destruction of fish and vegetation following tarring of roads, and of finding a high tar content in road washings. *Ibid.*, Vol. LXI, July 23, 1910, p. 99-100.
Letter (anon.) telling of experiments showing deadliness to trout at various dilutions of water which had been in contact with coal tar. *Ibid.*, Vol. LXI, July 30, 1910, p. 125-126.
Note by editor containing letter from "Elfa" telling of development of fungoid growth following the washing of tar from road into stream. *Ibid.*, Vol. LXI, Aug. 6, 1910, p. 144.
Note by editor quoting note from Percy Wadham on the road-tarring question. *Ibid.*, Vol. LXI, Aug. 20, 1910, p. 188.
Investigation of an epidemic of fish poisoning by tar at Drinkwater Park, Manchester, by E. J. Sidebotham and A. Sellers. (*From Archives of the Public Health Laboratory of the University of Manchester*, Vol. I, 1906.) *Ibid.*, Vol. LXI, Aug. 27, 1910, pp. 210-211.
1911. Note by editor quoting account from Dundee Courier of Aug. 5, 1911, of the washing by thunder storm of tar from freshly tarred road in the River Fary, the killing of many scores of fine trout, and the ruining of the fishing below. *Ibid.*, Vol. LXIII, Aug. 12, 1911, p. 163.
Letter from F. I. C., one technically informed, telling of amounts of naphthaline and phenol bodies allowed in road tar and maintaining that treatment which renders tar innocuous spoils it for road work. *Ibid.*, Vol. LXIII, Aug. 26, 1911, p. 233.

1912. Note by editor quoting letter from S. Jaffé telling of destruction of fish and small and microscopic forms by leakage of 2,200 cubic yards of tar and by-products and of over £1,600 paid in damages; and letter from Karl Heintz to the effect that it is illegal in Bavaria (or all Germany?) to construct drains from tarred roads into streams. *Ibid.*, Vol. LXV, Dec. 21, 1912, p. 582.
1913. Note by editor quoting extract from Isle of Wight County Press telling of settling with F. T. Mew, of Carrisbrooke, Isle of Wight, for £325 for damage to fishery by tarred-road washings. *Ibid.*, Vol. LXVI, Mar. 15, 1913, p. 66.
- Letter from Percy Wadham on the difficulty of determining the real danger from tar poisoning by laboratory experimentation. *Ibid.*, Vol. LXVI, May 24, 1913, p. 480.
1914. Note by editor quoting letter from F. Napier Sutton on the effect of leakage from gas works on a fishery. *Ibid.*, Vol. LXVIII, Jan. 3, 1914, p. 2.
1917. Note by editor quoting letter from Percy Wadham telling of lasting poisonousness of tar on roads and of formation of tarry strata on pond bottoms, etc. *Ibid.*, Vol. LXXIV, Feb. 24, 1917, p. 100.
1921. Report of address by J. A. Simpson delivered at Nottingham January 12 before "An Alliance for Prevention of River Pollution," telling of fining of Derbyshire County Council and of damages obtained by riparian owners for destruction of fishing by tarred-road washings. *Ibid.*, Vol. LXXXII, Jan. 22, 1921, p. 45.
- Note by editor to the effect that the Joint Committee of Ministry of Agriculture and Fisheries and the Ministry of Transport have been unable to find a safe tar; refers to an account by Dr. Smith, U. S. Commissioner Fisheries, of experiments to find a safe tar without success. *Ibid.*, Vol. LXXXII, Feb. 26, 1921, p. 117.
- FORBES, S. A.
1894. Report on effect of oil-well and gas-house waste on fish and fisheries of the Wabash River. In House of Representatives Miscellaneous Document No. 196, 53d Congress, 2d Session, p. 2-5. Also quoted by Richard Rathbun in Report of Commissioner, U. S. Commission of Fish and Fisheries for 1894 (1896), p. 109-112. Washington.
- HILDEBRAND, SAMUEL F.
1921. Top minnows in relation to malaria control, with notes on their habits and distribution. Public Health Bulletin No. 114, U. S. Public Health Service, Treasury Department, p. 17. Washington.
- HOME, DAVID MILNE
1883. Salmon and salmon fisheries. International fisheries exhibition. London, 1883. Conference on July 17, 1883. The Fisheries Exhibition Literature, Vol. VI, Conferences, Part III, 58 p. William Cloues and Sons, Limited, London.
- LENZING, C. W.
1917. Effect of gas-house waste on the biochemical oxydation of sewage. University of Illinois Bulletin, Vol. 15, No. 11, Water Survey Series No. 15, Chemical and Biological Survey of the Waters of Illinois, Report for . . . 1916, p. 168-174. Urbana.
- MCDONALD, MARSHALL
1885. Report on the pollution of the Potomac River by the discharge of waste products from gas manufacture. Bulletin, U. S. Fish Commission, Vol. V, 1885, p. 125-126. Washington.
- Effect of waste products from Page's ammoniacal works upon young shad fry. *Ibid.*, p. 313-314.
- MARSH, MILLARD CALER
1907. The effect of some industrial wastes on fishes. (*Reprint from The Potomac River Basin*, U. S. Geological Survey, Water Supply and Irrigation Paper No. 192, p. 337-348.) U. S. Fisheries Doc. No. 619. Washington.
- MOORE, GEORGE T., and KARL F. KELLERMAN
1905. Copper as an algicide and disinfectant in water supplies. Bulletin 76, Bureau of Plant Industry, U. S. Department of Agriculture, 55 p. Washington.
- MOSELY, MARTIN E.
1920. Trout fishing and road tarring. Salmon and Trout Magazine, No. 21, March 1920, p. 70-73. London.

- RICHMOND, F. G. 罟
1914. Some questions of tar. *Salmon and Trout Magazine*, No. 9, December, 1914, p. 35-42. London.
- RUSHTON, W.
1921. Biological notes. *Salmon and Trout Magazine*, No. 25, April, 1921, p. 114. London.
- SALMON AND TROUT MAGAZINE. LONDON.
1916. Road tarring. *Salmon and Trout Magazine*, No. 14, October, 1916, in Editorial Notes, p. 6-7.
1919. The road-tarring question. *Ibid.*, No. 18, April, 1919, p. 51-57.
Road tarring. *Ibid.*, No. 20, November, 1919, in Editorial Notes, p. 7.
1920. Road tarring and fisheries.—Work of the Joint Committee. *Ibid.*, No. 23, September, 1920, in Editorial Notes, p. 9-10.
- SCIENTIFIC AMERICAN.
1921. When oil stops the shifting sands. *Scientific American*, Vol. CXXV, No. 5, July 30, 1921, p. 83. Munn & Co., New York.
- SEYDEL, E.
1914. Über die Wirkung von Mineralölen auf Fischwasser. *Mitteilungen des Fischereivereins, f. d. Provinz Brandenburg*, Bd. 5, p. 26-28. Reviewed in *Wasser U. Abwasser*, Bd. 7, p. 49.
- SHELFORD, VICTOR E.
1917. An experimental study of the effects of gas waste upon fishes, with especial reference to stream pollution. *Bulletin, Illinois State Laboratory of Natural History*, Vol. XI, Art. VI, p. 381-412. Urbana.
- SHIPLEY, A. E.
1921. Oil from ships. Effects of discharge in the sea. *Suffering fisheries*. Letter to the editor, *London Times*, January 21, 1921, p. 6.
- THOMAS, ADRIAN.
——. A study of the effects of certain oils, tars, and creosotes upon brook trout (*Salvelinus fontinalis*). Manuscript.
- TOWNSEND, CHARLES H.
1908. Pollution of streams—an appeal to anglers. Reprinted from the twelfth annual report of the New York Zoological Society, 1908, 7 p. New York.
- WARD, HENRY B.
1919. Stream pollution in New York State. A preliminary investigation of the problem from the standpoint of the biologist. Made in July and August, 1918. State of New York Conservation Commission, Albany. J. B. Lyon & Co., Printers.
- WEIGELT, C.
1904. L'assainissement et le repeuplement des rivières. Traduction française de C. Julin. (Extrait du tome LXIV, *Mémoires couronnés et autres Mémoires, publiés par l'Académie royale de Belgique*, 1903.) 668 p. Carl Heymanns Verlag, Berlin.
- WHIPPLE, GEORGE CHANDLER.
1914. The microscopy of drinking water. 409 p. John Wiley & Sons, Inc., New York.
- WILSON, H. MACLEAN and H. T. CALVERT.
1913. A text-book on trade waste waters: their nature and disposal. XII, 340 p. C. Griffin & Co., Limited, London.

PROGRESS IN BIOLOGICAL INQUIRIES, 1921.

REPORT OF THE DIVISION OF SCIENTIFIC INQUIRY FOR THE FISCAL YEAR 1921.¹

By R. E. COKER,²

Assistant in Charge of Scientific Inquiry.

CONTENTS.

| | Page. |
|---|-------|
| Introduction..... | 4 |
| Studies of fishes..... | 5 |
| The Pacific salmon..... | 5 |
| Immature salmon in the ocean..... | 6 |
| Results of marking experiments..... | 7 |
| Salmon investigation in Yukon River..... | 7 |
| Chemical studies of salmon..... | 9 |
| Life histories of marine fishes..... | 10 |
| Fresh-water fishes..... | 11 |
| Whitefishes of the Great Lakes..... | 11 |
| Fishes of Wisconsin lakes..... | 13 |
| The paddlefish..... | 14 |
| Poisonous action of gar roe..... | 14 |
| Fishes of the Panama region..... | 15 |
| Pacific herring..... | 16 |
| Use of fish in combating malaria..... | 16 |
| Cooperation in antimalaria campaign..... | 16 |
| Conditions governing abundance of mosquito-destroying fish..... | 17 |
| Mosquito control in northern waters..... | 18 |
| Fish-cultural experiment work..... | 19 |
| Experiments in propagating and rearing fish in ponds..... | 19 |
| Water beetles in relation to pond culture..... | 20 |
| Studies of Salmonidae in relation to fish culture..... | 20 |
| Minnows in relation to fish culture..... | 21 |
| A new form of pond outlet..... | 21 |
| Eradication of some objectionable plants..... | 24 |
| Studies of fish disease..... | 25 |
| Mortality in pike-perch eggs..... | 25 |
| Abnormal conditions of fish ovaries..... | 25 |
| Disease of rescued fish..... | 26 |
| Parasitic flatworms of fresh-water fishes..... | 26 |
| Treatment of Ichthyophthirius disease..... | 27 |
| Oceanographic and limnological studies..... | 28 |
| Investigations in the Atlantic..... | 28 |
| Survey of Chesapeake Bay..... | 29 |
| Survey of selected areas in Mississippi River..... | 29 |
| Studies of inland lakes..... | 30 |
| Agar-agar and other gelatins from seaweed..... | 31 |
| The oyster..... | 32 |
| Investigations of oyster culture..... | 32 |
| Effect of pollutions upon propagation of oysters..... | 33 |
| Fresh-water mussels..... | 35 |
| Propagation of mussels..... | 35 |
| Protection of mussels..... | 35 |
| Mussel survey in upper Mississippi River..... | 36 |
| Experiments relating to mussel propagation..... | 36 |
| Investigations in the Kentucky River..... | 37 |
| The biological laboratories..... | 37 |

¹ Appendix VIII to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. No. 944.

² With the collaboration of the investigators.

INTRODUCTION.

The fisheries industries are immediately confronted with such acute problems of distribution of products that it would seem only natural if attention were temporarily detracted from the underlying and enduring problems of the industry—those relating to maintenance of the resources upon which the industries are based. Nevertheless the discussions among representatives of all phases of the industry when gathered together in such meetings and conferences as have been held during the recent period of stress have always brought to the front the problems that have to do with the perpetuation of fishery resources. Such conditions as the depletion of shad, the decline of the blue-crab fishery, and the deterioration of inshore waters through pollution, command such earnest consideration on these occasions as to prove that fishermen and dealers of broad vision are not misled through immediate difficulties in one department of the industry to minimize the importance of permanent sources of supply.

Upon due thought, of course, it is evident that the problems of supply must not be forgotten even momentarily; for the difficulties of distribution can be only heightened by continued depletion of resources and an inevitably accompanying increase in costs of production relative to the costs in competing industries. Obviously it can not become easier to market fish when they become less easily obtainable relative to other materials of protein food. No economic fact can be plainer than that diminishing abundance of fish must be followed by increasing prices and decreasing consumption.

It is, then, a fundamental and enduring principle that the perpetuation of the fisheries and the maintenance of their relative rank among other food-producing industries are contingent upon the continued productiveness of the fisheries—in a word, upon conservation. Conservation in turn depends upon the exercise of intelligence and restraint in the exploitation of fisheries resources, upon sound action in removing unnecessary causes of depletion, and upon wisdom in adopting plans for bringing about where possible an increase of particular fish or shellfish. The decline of valuable fisheries has been witnessed too often to admit of continued faith in the inexhaustibility of fish or shellfish of any kind. Yet the intelligent determination of what restrictive measures are necessary, what means of exploitation are unreasonable, or what plans of propagation or development are profitable can be made only upon the foundation of full and correct knowledge of the life histories, habits, and conditions of life of the fish that are to be considered.

It seems generally agreed, for example, that the blue crab of the Chesapeake is in actual course of extermination by unwise fishery methods, although there may not yet be agreement as to the particular methods which are unwise. Recently this very important question was referred to a conference of representatives of the two States concerned, together with officers of the Department of Commerce. The practical results of such a conference depend much, of course, upon the sound practical judgment and the broad spirit of those bearing the responsibility for determination of action; but the one indispensable basis of action is an understanding of the life of the crab. The sole hope of practical results from a conference of any group of persons having this problem in view rests upon such

knowledge as we have of the life history of the crab—in short, upon the results of scientific work previously done. Emphasis must be put upon the adverb of time. The significant thing is that the work must in great part, at least, have been already done; for knowledge can not be secured immediately; one can not produce the life history of an aquatic animal upon demand; it is the result of painstaking study through a period of time which can not be fixed in advance, and by the application of methods which can not be definitely plotted beforehand.

It is work of this kind which must be done, and continuously done, so that gradually and steadily we learn more and more about our fishery animals, if we are to be ready at all times to meet the changing problems of regulation and exploitation as they arise.

The scientific knowledge which is the basis of the future welfare of the fisheries requires not only time and application, but also skill and special training. Of greatest importance are the services of men who have not only natural qualifications and the preliminary training which institutions of learning can give, but also such special experience, interest, and devotion as can be gained only as the result of prolonged application to fisheries studies. Something may be done with inexperienced and changing agents, but the most successful and economical work will be done with a trained and continuing force.

In the following report will be found not an account of what might have been done, or what ought to have been done—but rather a statement of the progress which has been attained under the difficult conditions by which the scientific work of the Bureau has been circumscribed. It may be added that the Bureau again closes the year with a less effective force than it had at the beginning. Two members of the already depleted staff have resigned to accept better paying positions elsewhere, and two (including one rendering largely volunteer service) have died and not been replaced. Special acknowledgments are due to those whose interest and loyalty have held them in the public service.

In reviewing the subject of investigation it must be understood that while the Bureau has a definite policy of restricting expenditures to investigations of the most direct practical bearing, it is not entirely untrammelled in the selection of subjects of investigation. The qualifications of the personnel available necessarily determine in part the character of problems which can be profitably attacked.

STUDIES OF FISHES.

THE PACIFIC SALMON.

When consideration is given to the magnitude of the industries based upon the salmon and their near relatives, to the unrivaled rank which some of these fishes hold in the realms of sport and recreation, to the comparative ease with which the more important species may be brought to virtual extermination, and to the fact that all important species are the subject of artificial propagation, it is apparent that no group of fishes demands a greater share of attention in the way of scientific study.

For many years investigations have been directed particularly at the Pacific salmon, and the facts of life histories which are easiest to secure have been acquired, but yet we are far from having possession of the full knowledge necessary to direct propagation most efficiently, or to determine correctly the restrictive measures which may be enforced with least interference with the proper utilization of the fishes. The problems before us now are those requiring the closest and most persistent study, and yielding solution only slowly and by small stages.

IMMATURE SALMON IN THE OCEAN.

The investigations of salmon in Pacific Coast States have been conducted by Willis H. Rich, special assistant. The study of salmon taken by troll and purse seine in the open ocean has practically been completed. A preliminary report was prepared and, by authority of this Bureau, was published by the California Fish and Game Commission. The conclusions reached may be briefly summarized.

The fish taken in the ocean off the mouth of the Columbia River contain, in the spring and early summer, approximately 70 per cent of individuals which will not become sexually mature for one or two years, but by the middle of August this condition has changed so that nearly 90 per cent are fish which will soon enter the river for the purpose of spawning. The rate at which this change takes place and the time at which it occurs have not yet been determined, but will be taken up in a later report. A comparatively small percentage of the fish found just within the mouth of the Columbia River are immature. It should be mentioned in this connection that it is only occasionally, when unusual tidal conditions obtain, that any immature fish are taken inside the mouth of the stream.

The fish taken by troll in Monterey Bay in June contain a considerable proportion of immature individuals. The data obtained in 1918 are most reliable and indicate that only about 40 per cent of the fish taken would have spawned during the same year. The data for 1915 indicate that 75 per cent were mature, but selection may well have taken place in making this collection which consisted of egg samples only.

The fish taken near Drakes Bay and Fort Bragg in July and August, 1918, contain approximately 30 per cent of immature fish. It is of interest to note that this is an approach to the conditions found off the mouth of the Columbia River in August and suggests that the composition of all the schools found near the coast changes materially during the summer season.

It is understood that the preliminary report was used to advantage in the recent movement restricting the operations of both trollers and purse seiners off the coasts of Oregon and Washington. Additional data will be embodied in a later report.

Incidental to the work with the fish taken in the ocean considerable data have been collected which will apply to the report dealing with the general life history of the chinook salmon. Progress has been made in the identification of races, and additional evidence from the scales of returned marked fish has confirmed the work done last year on the significance of the various types of nuclear growth.

RESULTS OF MARKING EXPERIMENTS.

Mr. Rich has also submitted a report on "Returns from the experiments on the marking of young chinook salmon on the Columbia River." The experiments were started in 1916-17 and described in Economic Circular No. 45.

The percentage of returns of marked salmon was rather low, but the results obtained are of some significance. Examination of the scales of the marked fish which have returned after a period of three to four years corroborates the theory that the arrangement of the concentric rings (circuli) provides an accurate record of the previous history of the fish. A study of the scales of these marked fish will, moreover, aid very materially in the solution of perplexing problems which have arisen in interpretation of the scales of the chinook salmon.

Facts gathered during the investigation throw some light upon the rate of spawning migration of adult chinooks, indicating that the rate is approximately the same as that previously determined for sockeye salmon passing through Puget Sound and the Fraser River, that is, some 10 to 15 miles per day.

Perhaps the most interesting and important contribution which these experiments have made to our knowledge of the biology of the salmon relates to the hereditary character of the factors determining the time of the year at which the adults enter fresh water and begin their upward migration to the spawning grounds. It is an important practical question whether or not it is necessary to breed from fish of the spring run in order to produce the spring-run fish, which are more desired than the fall-run fish. The evidence of the marking experiments gives some indication that spring-run fish will be derived from spring-run parents and fall-run fish from fall-run parents.

A comprehensive program of experiment has been planned to extend over a period of several years. Two new marking experiments have been started on the Columbia River in cooperation with the Oregon Fish and Game Commission, nearly 100,000 young chinooks having been marked at Little White Salmon station and the State hatchery at Bonneville.

SALMON INVESTIGATION IN YUKON RIVER.³

During 1920, from May until September, Prof. Charles H. Gilbert, temporary investigator, and Henry O'Malley, field assistant in charge of Pacific coast work, conducted an investigation in Yukon River with reference to the runs of salmon, the commercial packs in and near the mouths of the rivers, and the requirements of the natives and others dependent on the runs of salmon in the Yukon River system. Data were secured for a comparison of conditions prevailing in 1919 and 1920. The primary object was to determine whether or not commercial fishing for export should be allowed in the Yukon River and its tributaries.

While all five of the Pacific coast species of salmon make their appearance at the mouth of the Yukon, only three species have sub-

³Cooperative investigation by Divisions of Fish Culture, Alaska Fisheries, and Scientific Inquiry. Only the biological data are summarized here. The full report is published on pp. 128-154 in *Alaska Fishery and Fur-Seal Industries in 1920*, by Ward T. Bower, Appendix VI, Report of the U. S. Commissioner of Fisheries for 1921, B. F. Doc. No. 909.

stantial runs in the Yukon River (king, chum, and coho), and of these king and chum are of the greatest importance by far. The few reds or sockeyes taken near the mouth of the river are perhaps strays, for no breeding has yet been reported from any part of the Yukon Basin. Humpbacks appear at the mouth of the river more numerous than the red salmon, but never in sufficient numbers to constitute a run even of small dimensions. As they were far advanced toward spawning in July, it was evidently impossible that they could ascend the river far with their spawning period so close at hand. The coho runs more or less numerous than the king or chum salmon and in addition is the latest to appear, often not presenting itself in any numbers in the middle and upper reaches of the river until the ice is forming in the fall.

The king salmon begins running in the last week of May or the early days of June. The run culminates quickly and then almost as quickly declines. The rate of migration was found to be remarkably high, the average rate of travel from Tanana to Dawson being slightly less than 45 miles per day, and from Pilot station to Dawson, involving practically the entire length of the river below Dawson, the average rate was 57 miles per day. No record of any other river approaches this in completeness, nor in the high rate of travel indicated. This unexampled speed with which salmon ascend the Yukon is doubtless associated with the great distances to be traversed before reaching their upper spawning areas, taken in connection with the shortness of the summer season.

The most important natural enemies of the king salmon are the white whales, or belugas, and the lamprey eels, the former being undoubtedly exceedingly destructive, while the latter, though causing scars on the fish in much greater abundance than in any other river, as observed by investigators, do not appear to effect serious injury to the fish.

The chum salmon, which is the principal food product of the Yukon River, made its appearance but a few days later than the advent of the king salmon, the rate of migration being approximately the same as that of the king.

Two phases in the development of the chum salmon are distinguished by the natives under the names of "dog salmon" and "silver salmon," the dog salmon comprising the individuals furthest advanced toward spawning. In general the "dog salmon" along any stretch of the river consist of those individuals which will turn into some adjacent tributary to spawn, while the "silvers" are on their way to the upper reaches of the river, show relatively little of the sexual changes they will exhibit on their spawning beds, and are still richly provided with the oil which serves as fuel and the principal source of nourishment during the long journey still before them.

"Dogs" and "silvers" were in general keeping apart from each other and following distinct migration routes, the "dogs" predominating on the right and the "silvers" on the left side of the stream. Heavier runs of kings and cohos were found in company with the "silvers" along the left limit of the river. It appears, therefore, that there is a prevailing use of the left shore by those fish which are found in the upper reaches of the river. This may have

connection with the fact that the majority of the tributaries of the lower river enter on the right bank.

Fishermen recognize the succession of phases in the run—the chums which accompany the king salmon being of relatively small size and poor quality, after which there is a run of bright fish of good quality, but inferior size (“silvers”), and finally the last run of “silvers” of a bright rich form and of distinctly larger size. This last run of “silvers” is ordinarily of short duration and furnishes the most highly prized fish of the season. A further more detailed study of the characteristics of the chums at different times and in different localities and the distribution of the various strains to their respective spawning areas would offer results of importance from the biological and equally from the strictly practical points of view.

The investigators record their opinion that the king salmon of the Yukon is the richest in oil of any known king salmon, and express the same view with even greater emphasis regarding the Yukon chums. In this connection it is remarked that in other river basins the chums do not travel far from the sea, but enter late in the season to seek spawning beds not far inland, while the best of the Yukon chums travel 1,000 to 2,000 miles up a river known for its consistently rapid current.

Consideration was given to the passage through which the salmon enter the river, and the investigators considered it not beyond the bounds of probability that nine-tenths of the salmon run enter by the Kwikluak Pass and its subsidiary channel, the Kwiguk.

CHEMICAL STUDIES OF SALMON.

Without expense to the Bureau, Prof. C. W. Greene, of the University of Missouri, has continued his chemical studies of material collected several years ago to determine the changes in salmon ovaries and tissues during the period of migration from sea to breeding grounds. The results of such studies can at first be given only technical expression, but they are none the less likely to yield in the end data of direct economic value.

The chemistry of the king salmon ovaries during their development in the migration period followed in the year 1908 on a series of samples collected on the Columbia River and its tributaries has been tabulated and prepared for publication.

These studies show the following major points: First, the growth of the ovary takes place primarily during the migration while the salmon is fasting. The average increase in weight is from about 135 to 150 grams at the end of the feeding period to 2,000 to 2,500 grams at maturity. In short, about 90 per cent or more of the development takes place during the prolonged fast of the migration.

Chemical analyses of developing ovaries show that between the 500-gram stage and the mature-egg stage there is a remarkable uniformity of chemical composition. The proteins are high, averaging from 29.38 to 31.16 per cent. This is undoubtedly all stored protein. The neutral fats decrease with the development and migration, from an average of 14.15 per cent at the mouth of the river to 10.83 per cent at the spawning. Phospholipins average 4.78 at the mouth of

the river and 2.85 at the spawning, showing a decrease with development. The phospholipins are much lower than in the yolk of bird eggs, the hen's egg averaging 11 per cent. The water-soluble organic extractives and the ash are both remarkably uniform, the extractives averaging 1.87 to 1.65, the ash 0.66 to 0.81 per cent. The organic extractives and ash are both low in comparison with other salmon tissues, but compare favorably with their percentages in the yolk of other eggs.

The salient points in this study are found in the showing of high protein storage in the salmon-egg yolk, the relatively low percentage of neutral fats and of phospholipins, and the decrease of neutral fats and phospholipins during development. Since in other eggs these fatty constituents are higher and tend to increase with development, it is probable that in the salmon the decrease is due to the extreme drain on the fatty deposits for the production of dynamic energy during the migration.

Determination of carbohydrate content of certain tissues of the king salmon during the spawning migration was undertaken as an accessory test. The gross samples were preserved in alcohol, and in the final analysis all glycogen was converted to glucose and the determination made in that form. The results show a very low glucose content of all organs and tissues. Glucose was present in all the tissues of the feeding salmon, Monterey Bay and Bolinus Bay specimens, but was absent or in reduced amount in the migrating and spawning salmon, with the exception of one tissue, the ovaries. In the ovaries, the percentage of glucose was practically constant throughout the migration.

LIFE HISTORIES OF MARINE FISHES.

During July and August, 1920, studies of the life histories of fishes of the middle Atlantic coast were carried on by W. W. Welsh, scientific assistant, aided by C. M. Breder, at a temporary station on Young's Pier, Atlantic City, N. J. Through the courtesy of Capt. J. L. Young, owner of the pier, a serviceable two-room building, formerly used as a wireless telegraph office, was adapted for use as a laboratory. A small hatchery, equipped with tidal box and Chester jars, was set up and supplied with filtered salt water from the pier aquarium. A great variety of material was obtained from the two pound nets operated under the pier. Eggs of several species, obtained from fish taken in these nets, were hatched in Chester jars, and the fry carried on as long as possible for study. Series of scale samples for the determination of age and growth were also taken.

Among the species studied were northern and southern king whiting (*Menticirrhus saxatilis* and *M. americanus*), squeteague (*Cynoscion regalis*), spot (*Leiostomus xanthurus*), croaker (*Micropogon undulatus*), silver perch (*Bairdiella chrysura*), menhaden (*Brevoortia tyrannus*), and puffer (*Spherooides maculatus*).

Although the facilities generously furnished by Capt. Young could hardly have been improved upon, the work was greatly handicapped by the abnormally cold water which prevailed throughout the summer. Water temperatures ranged from 53 to 65° F. and averaged about 57° F. This low temperature is believed to be the cause of the

scarcity or entire absence of a number of species which it was hoped could be obtained and studied.

The same investigators completed during the year a valuable report on the life histories of fishes of the family *Sciaenidae* of the Atlantic and Gulf coasts. The family includes some of the most important food fishes, the annual catch on these coasts approximating \$3,000,000 in value. No less than 37½ per cent of the fish landed at the municipal fish wharf, Washington, D. C., in 1919 were of this family: the principal species were the squeteague, or weakfish, often erroneously called sea trout, the highly esteemed king whiting, the red drum, or channel bass, the croaker, spot, and silver perch.

How can we act intelligently with reference to the exploitation of such resources or determine wisely how to preserve them for all time if we do not know the life histories of the fishes, when and where they breed, their migrations in summer and in winter, the rate of growth, and the food they require? The present report not only brings together the fragmentary data hitherto available but adds materially to existing knowledge by embodying the results of years of researches, particularly those of the senior author, whose death unfortunately preceded the final completion of the paper.

The report also serves the valuable purpose of making evident the gaps in existing knowledge, revealing the need of additional observations, and showing plainly the directions which further studies should follow. As similar work is done for other families of fishes we shall come nearer to realizing the practical value of applying science to the study of fishes.

Mr. Welsh also completed descriptions of seven new species of marine fishes (*Malacopterygii*) taken during the explorations of the United States Coast and Geodetic Survey steamer *Bache*, conducted in 1914 under the direction of the United States Bureau of Fisheries. The fish were taken at various stations in the vicinities, respectively, of Cape Hatteras, the Bermudas, and Bahama Islands. After Mr. Welsh's death the descriptions were prepared for publication by C. M. Breder. The report has been accepted for publication by the United States National Museum.

Both assistants have been lost to the Bureau during the year, the one by untimely death, the other by resignation.

FRESH-WATER FISHES.

WHITEFISHES OF THE GREAT LAKES.

There is scarcely a sadder feature of the history of American fisheries than the progressive depletion of the important resources of the Great Lakes, notably in respect to the whitefishes. We may have overestimated the possibilities of exploitation, we may have been shortsighted in the fishery policies we pursued, or we may not have propagated them with proper energy or efficiency. But the simple fact is that no one has had enough knowledge of the distribution, habits, and requirements of whitefishes to give proper advice. The best intentions can not save a situation when founded upon ignorance. If the whitefish fisheries of the Great Lakes are to be preserved to the future or perhaps restored in part to their earlier rank, we must study the fishes and ascertain the condition of their existence.

Therefore, for several years the Bureau has had a skilled assistant devote exclusive attention to the whitefishes and related species. This investigation, pursued by Walter Koelz, scientific assistant, is not all that is required, but it will surely provide a fund of information for more intelligent guidance in future.

The investigation of the systematic relationships and habits of the coregonines was conducted in the year 1920 on Lake Michigan. Forms allied to those which the investigations of the previous year disclosed in Lake Huron, and in addition two undescribed species, of which at least one is now known to occur also in Huron, were obtained. Diagnoses of the species have been prepared from over 2,000 preserved specimens. Data have been collected bearing on the distribution in the lake and on the spawning habits of the various forms. To avoid dissemination of premature conclusions a report will not be published until work is done upon other lakes.

These studies have been supplemented by microscopic examination of the scales and systematic investigation of the food, conducted, respectively, by John Van Oosten and Carl L. Hubbs, temporary investigators, under the direction of Prof. Jacob Reighard.

Mr. Van Oosten first determined that the scale characters of the lake herring (*Coregonus artedii*) are so well defined as to permit the determination from them of the age of individuals and the rate of growth of the species. The variations in the scales of individuals were found to be within specific limits. But scales from different parts of the body of an individual are so unlike that for comparison of individuals or species it is necessary to use scales from the same body region.

The scales of 10 specimens of each of the 10 Lake Huron forms recognized by Koelz were next compared, and it was found that 8 of them (including the two races) are discriminable. Further study will probably enable discrimination of the two other forms. It appeared that in one of these forms (*Coregonus artedii*) there are probably two geographic races which differ in rate of growth, but the matter needs further study.

Through the courtesy of Dr. C. H. Townsend, director of the New York Aquarium, it was possible to secure specimens of whitefish (*Coregonus clupeaformis*) hatched and reared at the aquarium and therefore of known age (7 years). The 10 specimens studied show that there is one annulus for each year of age. This, so far as known, is the first demonstration of this fact and enables the determination of the age of coregonine fish from scale characters to be undertaken with confidence. Two individuals of the 7-year-old whitefish were segregated at the New York Aquarium and kept living, while scales were removed at intervals of a month. A study of these scales shows that the annuli are formed in winter, fixes the time of formation, and indicates temperature change as one of the factors. It is believed that a continuation of these studies will add materially to our knowledge of age and rate of growth of coregonine fishes, aid in their systematic grouping, and lead to the discovery of local races in some of the forms.

The food of the whitefish, lake herring, and allied species of Lake Huron coregonines in the Koelz collection was investigated by a volumetric method by Carl L. Hubbs, of the Museum of Zoology,

University of Michigan. The deep-water forms, as the blackfin (*Leucichthys nigripinnis*), were found to feed almost exclusively upon the crustacean *Mysis relicta*, probably the only available food. The deep-water race of the bloater (*Leucichthys hoyi*) feeds chiefly on *Mysis*, while a 30-fathom race eats for the most part another lake crustacean, *Pontoporeia hoyi*. The food of the shallow-water forms is much more varied. The pilot or menominee (*Prosopium quadrilaterale*) is strictly a bottom feeder, subsisting on mollusks, insect larvæ, crayfishes, etc. The whitefish (*Coregonus clupeaformis*) is also a bottom feeder, but its food is, on the average, not so coarse as that of the pilot, consisting largely of insect larvæ, as those of the mayflies *Hexagenia* and *Ephemera*. The lake herring feeds in part upon the same animals, in part upon the minute Crustacea of the plankton. In reference to their available food supply the deep-water forms are absolutely competitive (more so perhaps than any other group of fishes), while the shallow-water forms are only in part competitive. It is probable, however, in view of the former greater abundance of these fishes, that sufficient food exists in the lakes to support a larger population of all the species of whitefishes.

FISHES OF WISCONSIN LAKES.

The food and distribution of the fishes in certain Wisconsin lakes have been studied by Dr. A. S. Pearse.⁴ The results indicate that in summer fishes are generally more abundant as conditions approach those in swamps and are fewest when the environment is most like that in rivers. When food is present in quantity and when other conditions are favorable, there are more fishes per unit area in certain inland lakes than in the Mississippi River or in Lake Michigan. Lakes produce considerable food supplies within themselves, while rivers are more dependent on swamps, ponds, and other tributaries. The factors of importance in limiting the distribution of fishes are discussed (shores, turbidity, depth, bottom, height of water, currents, etc.). An abundant supply of food and vegetation permits many fishes to *exist* in a lake, but other favorable conditions must be present in order that they may grow to large size.

A statistical study of the infection of fishes by parasites has been made, the Mississippi and St. Lawrence drainage systems being compared, and various types of lakes studied. The results are now being tabulated and will soon be ready for publication. A short paper on the habits of the mud puppy, in which its relations to fishes are discussed, has been published.⁵

In order to secure information on the rate of growth of cold-blooded animals in natural conditions, attempts are being made to recover the fishes and turtles tagged and released in Lake Mendota during the summer of 1919. Some specimens have already been secured.

Studies on the metabolism of fishes are being continued. In this connection quantitative analyses are being made to show the water, ash, nitrogen, and other extractives of fishes at various stages of growth.

⁴ PEARSE, A. S.: The Distribution and Food of the Fishes of Three Wisconsin Lakes in Summer. University of Wisconsin Studies in Science, No. 3, June, 1921, 60 p. Madison.

⁵ PEARSE, A. S.: Habits of the Mud-Puppy *Necturus*, an Enemy of Food Fishes. Bureau of Fisheries, Economic Circular No. 49, issued May 16, 1921, 8 p. Washington.

THE PADDLEFISH.

The study of the natural history and artificial propagation of the paddlefish in Bayou Pierre at Westdale, La., was continued by Dr. A. D. Howard, scientific assistant, with the cooperation of the Louisiana Conservation Commission. During March good catches of egg-bearing females and sufficiently ripe males were obtained, but no females were ripe enough to allow of fertilization of eggs. Late in the month heavy rains flooded the Red River and Bayou Pierre and prevented the capture of fish in sufficient numbers to continue the investigation.

There are few added data regarding the breeding grounds of the fish and the time and manner of spawning. Some information of minor importance was obtained regarding certain habits of the species. Bottoms suspected of being the breeding grounds of the paddlefish were dredged for the purpose of obtaining eggs, but without success.

POISONOUS ACTION OF GAR ROE.

In a previous year experimental attempts to produce caviar of gar roe were made by Prof. C. W. Greene, temporary investigator. Out of this work it developed that the pigment in the gar roe is not a melanin as in the sturgeon roe, but a form of pigment that changes color under various chemical treatments of the roe. The pigment color is changed to an orange red on boiling the gar eggs, on treatment with alcohol or ether, and on salting. This changes the commercial quality of the product and gives easy methods for detecting the adulteration of sturgeon roe by gar roe.

The important observation, however, was the demonstration of an active physiological principle of a toxic nature present in gar roe. It is apparently this principle that gives the unpleasant acrid taste to gar-roe caviar. When tested biologically by the method of feeding the natural product the following points were made: (1) Gar roe is poisonous to the chicken and to the rat; (2) it paralyzes the neuromuscular mechanism of the chicken crop; (3) it produces in the rat an intestinal irritation with active diarrhea.

During the summer of 1920 a series of experiments were made to chemically separate and biologically test the unknown toxic substance. It was shown that (1) extracts in boiling water free from coagulable protein and (2) similar alcoholic extracts contained an active principle toxic to the heart of the frog; (3) globulin fractions made by the method of salting out, centrifuging, and purifying by dialysis were sharply toxic to the heart; (4) the globulin fractions fed to a young rat produced extreme diarrhea and death in about 20 hours, effects comparable to feeding the entire fresh ovary; (5) the effect on the chicken's crop was positively toxic; (6) not only was the crop paralyzed but an acute diarrhea occurred in the chicken through some alimentary canal poisoning; (7) these effects also occurred after feeding the purified globulin.

Attempts to isolate and identify the individual chemicals, of which at least two classes are present, have thus far not been brought to a successful issue. Further experiments are planned.

FISHES OF THE PANAMA REGION.

The Bureau of Fisheries, late in 1910, entered into an agreement with the Smithsonian Institution and the Field Museum of Natural History for a cooperative study of the fishes of the Panama Canal Zone. The work was carried on under the auspices of the Smithsonian Biological Survey of the Panama Canal Zone. The field work was done by Dr. Seth E. Meek, of the Field Museum, and Samuel F. Hildebrand, of the Bureau of Fisheries, during two expeditions made to the Canal Zone, from January to June, 1911, and January to March, 1912, respectively. The study of the collections which were sent to the National Museum was begun during the interval between the two expeditions and continued after the second visit to Panama by the collectors. After two small preliminary papers containing descriptions of new species of fresh-water fishes had been written, and a majority of the forms had been roughly identified and separated, Dr. Meek was obliged to withdraw from the work because of an illness from which he never recovered. The completion of the work was then left to Mr. Hildebrand. As other duties were necessarily assigned to Mr. Hildebrand from time to time, the completion of the study of the collections was greatly delayed. The final report on the fresh-water fishes, however, was completed and published in 1916, but the study of the marine forms was not completed until the spring of 1921. In the last months of the work the author was assisted by W. C. Schroeder.

The total number of species recorded from the coasts of Panama, either taken by Messrs. Meek and Hildebrand, or previous collectors, or both, is 640. The remainder of the species included in the paper were discussed because their known range of distribution is such that they may be expected on the coasts of the Isthmus. The fishes on the Pacific coast run larger than those on the Atlantic and are more numerous both as to species and individuals. Much more collecting, however, has been done on the Pacific side than on the Atlantic, which undoubtedly accounts in part for the large difference in the number of species recorded. The total number of species listed as common to both coasts of Panama is 72, but of these 48 are more or less cosmopolitan in their distribution, that is, they are not confined to American waters. A very large number of species considered distinct are, however, very closely related, differing only slightly but in apparently constant characters.

It was pointed out in the report on the fresh-water species that the fishes of the opposite slopes of Panama are very closely related, some of them remaining identical. This close relationship indicates that the fishes of the two slopes had not long been separated. Since the opening of the Canal they, of course, can again freely intermingle in those streams which are connected with the Canal. The close parallelism of the marine species of the opposite coasts is evidence of a comparatively recent passageway from ocean to ocean, even for salt-water forms. The genera of many families have representatives on both coasts, and if they do not include identical species they at least have very closely related forms on the opposite coasts. A few families, however, deviate from this general rule in having many more representatives on one coast than on the other. The reasons

for this may be found by consideration of the habits of the species of those families which do not conform to the usual rule. The Siluridae (including the catfishes), for example, are very much more numerous on the Pacific coast than on the Atlantic. The Scaridae (including the parrot fishes and viejas), on the other hand, are much more numerous on the Atlantic than on the Pacific. It is well known that most catfishes frequent water with soft or muddy bottom. The Pacific coast of Panama has many large mud flats partly or wholly exposed at low tide but flooded during high water. The Scaridae prefer rocky bottom, and especially coral reefs, which are large and extensive on the Atlantic side. These conditions undoubtedly prevailed, in part at least, before the last passageway between the two oceans was closed, and it is probable that these families had already sought out regions best suited to their particular needs.

The commercial fisheries of Panama are still largely undeveloped. The possibilities for profitable fisheries appear to be especially good on the Pacific coast, but apparently less promising on the Atlantic side of the Isthmus. The people of the Isthmus are less wasteful of fishes than the people of the United States, as nearly all species of fish taken, including sharks and skates, are utilized as food.

PACIFIC HERRING.

During the year the Bureau issued a memorandum dealing with the distribution, migrations, sizes, and spawning times and places of the Pacific herring in southeast Alaska and British Columbia, based upon the observations of D. R. Crawford, scientific assistant.

There are apparently two races of herring (*Clupea pallasii*), one of which resides in the bays and inner waterways along the coast from Puget Sound northward to British Columbia and southeast Alaska. The other, which is composed of larger individuals, passes along the outer coasts where it is taken off Vancouver Island in June, July, and August.

The smaller race of herring is found to be sexually mature in the summer, but no milt or roe is found during the winter. Sexually mature individuals vary in size from 6 to 10 inches. The probable spawning time is late summer or early fall. The larger race of herring reaches sexual maturity in the fall and winter, the individuals varying in size from 9 to 12 inches or longer. The probable spawning time is winter or early spring.

USE OF FISH IN COMBATING MALARIA.

COOPERATION IN ANTIMALARIA CAMPAIGN.

Investigations of fishes in relation to mosquito control were conducted during the mosquito-breeding season of 1920 by Samuel F. Hildebrand, scientific assistant, working in cooperation with the United States Public Health Service. In the spring and early part of the summer Mr. Hildebrand inspected various localities in 12 Southern States where malaria-control work was to be undertaken. Suggestions were offered concerning the employment of fish for the control of the mosquito, and the waters suitable for fish control were pointed out to the officers in charge. The result of these inspections

was that the top minnow, *Gambusia affinis*, was very widely employed as an agent in the control of malaria. A report of observations made by Mr. Hildebrand during this campaign has been published by the Public Health Service.⁶

The latter part of the season was devoted to investigations at Savannah, Ga., where a special effort was made to determine the relative value as eradicators of mosquito larvæ of two other American viviparous species of fishes, *Heterandria formosa* and *Mollienisia latipinna*, both of which are abundant at Savannah. It was demonstrated that *Heterandria formosa* is of real value and is well worth careful consideration wherever it occurs. *Mollienisia latipinna*, on the other hand, appeared to be practically worthless.

The antimalaria campaigns in the various States were brought to a close early in November, in which month the annual meeting of the National Malaria Committee and the conference of sanitary engineers engaged in antimalaria work took place in Louisville, Ky., where the outcome of the past season's campaign was reported and discussed. The subject of mosquito control by the use of top minnows received extended discussion, and the fact was brought out that nearly every sanitary engineer had made use of *Gambusia affinis* as an agent in malaria control with excellent results. The saving of large sums of money was reported, because fish control replaced other methods at much less expense.

Similar advisory work was done by Mr. Hildebrand in the spring of 1921 before establishing headquarters at Augusta, Ga., for further investigations to determine more fully the conditions of effectiveness in the employment of fish for destruction of disease-bearing mosquitoes.

CONDITIONS GOVERNING ABUNDANCE OF MOSQUITO-DESTROYING FISH.

R. L. Barney and Barry Anson have continued the organization and summarizing of data collected at Mound, La., where investigations of the use of fish for control of mosquito breeding were previously conducted in cooperation with the Bureau of Entomology.

Reports⁷ printed outside the Bureau's publications demonstrate the varying seasonal frequency of *Gambusia*, the mosquito-eating fish; the seasonal variation in the proportions of the sexes and its bearing on the abundance of the species in nature; the effect of environment on the abundance of the species; and the relation of plants of varying habits of growth to oxygen supply and to the capacity of small ponds to support the top-minnow *Gambusia*. Further observations have been made on the seasonal abundance of *Gambusia*, especially in relation to the fecundity of the species. Appropriate consideration has been given certain points concerning the anatomy of the female reproductive organs of this fish.

⁶ Hildebrand, Samuel F.: Top Minnows in Relation to Malaria Control. With Notes on Their Habits and Distribution. Treasury Department, Public Health Bulletin No. 114, May, 1921, 34 p. Washington.

⁷ Barney, R. L., and Anson, B. J.: Relation of Certain Aquatic Plants to Oxygen Supply and to Capacity of Small Ponds to Support the Top-minnow (*Gambusia affinis*). Transactions, American Fisheries Society, 1920, pp. 268-278.

Abundance of the Mosquito Destroying Top-minnow *Gambusia affinis*, Especially in Relation to Male Frequency. Ecology, Vol. II, No. 1, January, 1921, pp. 53-69.

The study of the natural history and ecology of the pigmy sunfish, *Elassoma zonatum*, has been concluded and given publication.⁸ It appears that this fish, under certain conditions, may have some value in eradicating immature mosquitoes.

MOSQUITO CONTROL IN NORTHERN WATERS.

While in northern States mosquitoes have a less acute relation to public health than in regions where malaria is prevalent, they nevertheless constitute there a distinct menace to health and efficiency, besides being effective in causing a material reduction of property values, especially in regions which are normally resorted to for purposes of recreation and recuperation of vigor. During the year Prof. J. P. Moore, temporary investigator, has completed a report upon his observations of the use of fish and other aquatic animals for the control of mosquito breeding in northeastern States. His conclusions and suggestions may be summarized.

Although no fish to which mosquitoes are more than an incidental item of the diet has been found in the fresh waters of the northeastern States, nevertheless several species of small fishes and the young of some large ones native to these waters eat mosquito larvæ, pupæ, and eggs more or less habitually. The most important of these mosquito repressors are the common sunfish, the mud minnow, and the common killifish.

Fishes are found to be far more detrimental to culicine than to anophelene mosquitoes. While in the aggregate they destroy vast numbers of eggs, larvæ, and pupæ, and (along with other enemies) probably prevent mosquitoes from becoming everywhere an intolerable nuisance, the destruction is never complete. Some breeding of mosquitoes continues in nearly all bodies of fresh water even when well stocked with mosquito-eating fishes. This imperfect suppression arises through conditions limiting the efficacy of the fishes, most important of which are (1) the barriers that almost all natural bodies of water afford and which prevent the fishes from finding the young mosquitoes, and (2) the abundance of other food for the fishes. Most native mosquito-eating fishes will not thrive in water contaminated by excess of decaying vegetation or otherwise.

The most prevalent of the barriers is the shallow water and marginal vegetation. In ponds formed by dams provided with head gates a simple, effective, and economical method of controlling and reducing marginal vegetation is by lowering and raising the water level periodically, thus alternately drying and drowning the plants. In ponds and lakes of fixed level mechanical means of clearing the margins must be employed.

The most practical method of keeping the per capita food supply low is by overstocking with a variety of small fishes. Reduction of the vegetation also diminishes the supply of fish food.

The common sunfish (*Eupomotis gibbosus*) is the most useful species for ponds and lakes generally. With it may be associated the long-eared sunfish (*Lepomis auritus*), roach (*Abramis chrysolaucus*), some of the smaller minnows, black bass, etc. If there is much

⁸ Barney, R. L., and Anson, B. J.: Life History and Ecology of the Pigmy Sunfish (*Elassoma zonatum*). Ecology, Vol. I, No. 4, October, 1920, pp. 241-256.

aquatic vegetation the blue-spotted sunfish will prove a valuable addition, and if very shallow or swampy areas occur, the mud minnow. The common killifish is very effective in fresh and brackish tidal marshes, and the translucent killifish is useful in upland creeks and dams. Rapid multiplication of small fishes should be encouraged by providing suitable nesting sites and protection for the fry.

Gambusia, the favored top minnow of southern waters, has not survived the northern winters but multiplies so rapidly that it may be used effectively against both *Culex* and *Anopheles* in small ponds and water gardens by planting a small number each spring. Small goldfishes are useful in fountain basins and small ponds with clean sides, and, for use in rain barrels and tanks, are preferable to *Gambusia*.

FISH-CULTURAL EXPERIMENT WORK.

EXPERIMENTS IN PROPAGATING AND REARING FISH IN PONDS.

The Fairport station has continued its valuable experimental work in reference to the propagation and rearing of fishes in ponds. Certain observations were made on the value of fertilizing ponds with chemicals and manure, but data obtained to date are inconclusive. Further study will be directed toward this problem.

The small pond, which for several years has been handled as a farm pond with minimum care and expense, has yielded valuable information. Originally it was stocked with bluegill sunfish. Occasionally, when necessary, the pond has been wintered out. There has been no manipulation of the pond in any respect other than the control of the number of bluegills of various ages in it. During the past year the actual production of fish meat in the ponds has been 333 pounds per acre. Of this, however, fishes of edible size represented about 33 per cent of the total fish-meat production. In this connection it may be well to note that the average annual production of beef per acre on untilled meadowland is said to be 125 pounds; that for hogs is 225 pounds.

Buffalofish, *Ictiobus cyprinella*, artificially reared in the station ponds, reached maturity and produced young for the first time at the age of 4 years. They averaged 13.6 inches in length and approximately 2 pounds in weight. The small-mouth buffalofish, *Ictiobus bubalus*, which in previous years had failed to spawn in the experimental ponds unless an artificial rise in the level of the pond was produced, spawned this year in a pond in which the rise did not occur. While the production of fry of this species does not appear to be as numerous as for those fish held in the pond with artificial rise, the occurrence indicates that the rise is not entirely necessary, though it may be advantageous.

The channel catfish, *Ictalurus punctatus*, for which this station showed the feasibility of pond culture, has continued to spawn in the experimental ponds. Certain 4-year-old offspring of wild stock came to sexual maturity during the year and produced the first brood of truly domestic fish. The adaptability of this species to pond culture is suggested by the fact that the catfish has spawned in certain of the smallest ponds on the reservation, one of which has a water-surface area, when completely full, of only 3,485 square feet (less than one-twelfth of an acre).

WATER BEETLES IN RELATION TO POND CULTURE.

The home fishpond is a subject of continued interest among farmers and others who value the additional table food made available or the means of recreation provided. There must be a great deal in a pond besides fish; otherwise the fish would starve. There must be small animals which serve as food to fish and still smaller animals and plants which serve as food for them. Some things in a pond are desirable, others objectionable in varying degree. The fishpond is, indeed, not a simple thing, but a very elaborate complex, the scientific unraveling of which is necessary before the best plans of pond management can be known. The unraveling of the complex can be accomplished eventually only by tracing particular threads, that is, by centering attention at one time upon a particular group or species of the inhabitants of the water. An instance of such special studies carried through to a point where helpful practical conclusions are derived is afforded by the investigation of water beetles conducted at the Fairport station.

Dr. C. B. Wilson has made a comprehensive study of the rôle beetles play in pondfish culture. He has found that larvæ and adults of the three beetle genera, *Hydrophilus*, *Dytiscus*, and *Cybister*, destroy small fish under normal conditions. The larvæ of *Dineutes* are known to have killed and eaten fish fry under certain abnormal conditions. The larvæ of three other genera (*Acilius*, *Graphoderes*, and *Hydrocharis*) are suspected of being capable of committing similar depredation.

On the other hand, both beetle larvæ and adults are eaten freely by the young of nearly all our common food and game fishes after the latter attain a length of 25 to 40 millimeters. This is just as true of the seven genera mentioned above as of the others that are harmless.

Practically speaking, only the young fish of the year are menaced by beetles. Fish a year or more old are large enough to feed on the beetles and are almost never attacked by the latter. Consequently beetles are really harmful only in breeding ponds, and even in those places, as everywhere else, they contribute materially to the available food supply for the fish.

Adult beetles migrate and travel so constantly that every fishpond is sure to be stocked with them as soon as it is completed, and yet the beetles of two ponds side by side are likely to differ radically in numbers and variety. If they occasion trouble in one pond, the temporary removal of the fish to another pond will usually prove an effectual remedy. Beetles may also be kept in check by abruptly raising and lowering the water in the pond at intervals of a week or 10 days during their breeding season in July and August.

STUDIES OF SALMONIDÆ IN RELATION TO FISH CULTURE.

In a previous report reference in detail was made to the investigations by Dr. W. C. Kendall of rainbow and steelhead trout and of some hitherto unrecognized anatomical characters of trout which seemed to have a direct bearing upon fish-cultural practices. It is worthy of note that the results of the latter investigation were deemed of such value by independent persons that the report upon them was

awarded a prize by the American Fisheries Society as the most important contribution in the application of biological science to the advancement of fish culture. A series of practical experiments based upon these results was conducted during the winter at one of the fish-cultural stations of the Bureau. Just before the close of the year they were transferred to another station where more adequate facilities were available, and it is planned to continue them during the coming fiscal year that definite results may be obtained.

MINNOWS IN RELATION TO FISH CULTURE.

The smaller members of the minnow family are important to fish culture since they represent a primary source of food for more than 20 of the larger food and game fishes. The success of the introduction of game fish into streams or ponds necessarily depends to no small extent upon the suitability of the stream or pond for the support of minnows. Hence the budget of knowledge requisite for efficient fish culture includes information regarding the food and other requirements of minnows. Therefore, while the study of minnows by C. M. Breder and D. R. Crawford, scientific assistants, was conducted almost entirely outside of office hours and represents a by-product as it were, the results gained are of practical value.

They studied six common species in the vicinity of the District of Columbia: chub minnow, *Scotilus ballaris*; red-bellied dace, *Leuciscus vandersalis*; *Notropis procer*; shiner or red fin, *Notropis cornatus*; black-nosed dace, *Rhinichthys atronaso*; cutlip, *Ecoylossum maxilligut*. All were found to be predominantly carnivorous, insects forming the bulk of the food taken, although two species, *Notropis procer* and *Ecoylossum maxilligut*, consumed much vegetable matter. Various worms, filamentous algae, and diatoms entered into the food in considerable quantities. These minnows are, therefore, in direct competition with the young of important game fish and may even prey upon the fry of them. It is suggested, therefore, that if minnows are introduced into ponds as food for game fish, discretion should be exercised regarding the use of larger and more rapidly growing minnows, such as the chub minnow and red fin, which may outstrip young trout in growth and under some circumstances become a menace rather than a benefit.

In all cases the suitability of the introduction depends both upon the species of minnow and upon the species of fish which is to be fostered, as well as upon other conditions prevailing in the water and upon the degree to which the various factors are under the control of the fish culturist. Minnows seem to thrive best in streams or ponds where the banks bear overhanging vegetation that supports an abundance of insect life. Where this condition prevails there is probably less likelihood that the minnows will prey upon the eggs or young of other fishes.

A NEW FORM OF POND OUTLET.

Practical success in fish culture depends in no little measure upon economy in construction and operation of the pond and upon the convenience with which it can be drained for removal of brood stock or young, elimination of enemies, cleaning the bottom, or removing obnoxious plants. The concrete-box outlets commonly used are not

only expensive, but they are also frequently a subsequent source of annoyance, expense, and loss of fish, when damaged as the result of freezing and thawing. It is worthy of special comment, therefore, that H. L. Canfield, superintendent of fish culture at the Fisheries biological station, Fairport, Iowa, has devised a type of pond outlet which has been found, after long trial, to be both relatively inexpensive of installation and convenient and enduring in operation. The Canfield L outlet, here described and illustrated, provides both for all ordinary overflow and for draining the pond as easily and quickly as with the concrete outlet.

The outlet consists of two pieces of threaded pipe of required length screwed hand-tight into an elbow. When connected for service one pipe is joined to the drainage line, and the other, the elbow acting as a hinge, becomes a movable standpipe, the raising and lowering of which controls the depth of the water in the pond. A pipe stop about 2 feet high is arranged back of the elbow to stay the standpipe from passing the center.

Two or three cement blocks about 2 by 2 by 2 feet are set about the drainage line to anchor it and to give protection to the embankment against animals and water seepage leading into it along the line. These blocks serve also as couplings for the joining of the pipe to the drainage line and for other connections in the line as desired. When a kettle is used one block joins a side of it, anchoring the pipe connection with the drainage line and serving as a base for a walk support. A second block is placed about the drainage line approximately beneath the top and inside edge of the embankment. This is usually a drainage line connection block. If the drainage line passes entirely through the embankment a third block should be placed around it several feet into the embankment from the outside.

The outlet screen consists of a half coupling (whole coupling if desired) with a quarter-inch groove around it 2 inches below its top, to which is attached, by means of galvanized wire, a covered cylindrical screen of desired mesh, 1 foot high. This is screwed to the outlet pipe. A cylindrical or square screen of large proportion may be installed about the standpipe if maximum screen area is needed, although for general use this will not be required.

A cement kettle 12 by 6 by 1 foot set parallel to the embankment, and within this kettle a small kettle about 15 inches wide, 3 inches deep, and about 7 feet long (long enough and wide enough to admit the standpipe with screen, when down level) are used at Fairport with the L outlet. The drainpipe enters the side of the main kettle about 6 inches from the elbow and 1 foot from the end. The bottom of the inner kettle is made level with the base of the outlet pipe when it is down level in position to drain, and provision is made for the removal of the elbow by cupping out the cement beneath it and filling the space with clay, to prevent the trapping of fish when the pond is drained. The main kettle has a slight rise from the inner kettle to the sides to provide drainage.

A walk of 2-inch plank supported by 2 by 4 inch stringers is made to extend from the embankment to within a foot of the outlet screen, the stringers resting about 6 inches above the top of the outlet pipe when erect. This walk rests on two pipe supports which extend from the cement blocks in the drainage line.

The standpipe is chained to the sides of the outer walk support by a piece of galvanized pump chain the length of the distance the pipe travels. This chain passes through a loop eye in the post and is provided with a ring larger than the eye, so that the end of the chain can not be drawn through. By means of this chain the standpipe may be raised and lowered and the level of the water in the ponds adjusted and held as desired. An ordinary lock, or an iron bolt may be used to secure the chain in the loop.

Malleable iron pipe is excellent material for the outlet, but ordinary black steel pipe is cheaper and gives good service. One piece of pipe of required length for the standpipe, threaded both ends, an elbow, and about 2 to 2½ feet of pipe threaded one end, to serve as connecting pipe with the drainage line, are all the materials required for the outlet. It is recommended, however, that metal pipe be provided from the elbow well into the embankment for the better protection of the drainage line. Eight-inch pipe is recommended for ponds of 1 acre in area and proportionately smaller pipe for smaller ponds.

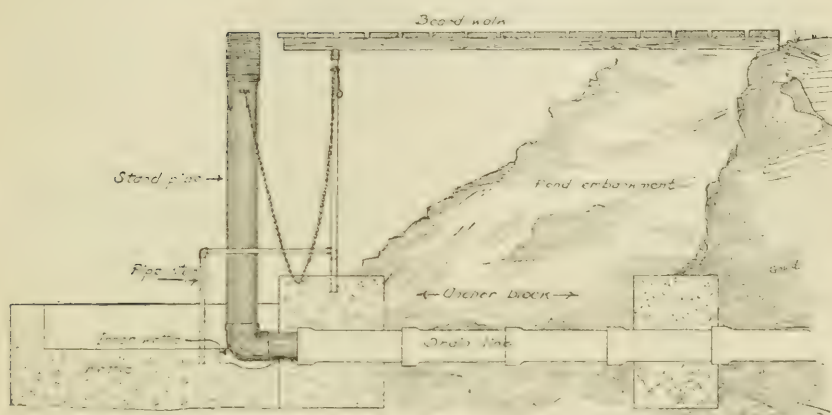


FIG. 1.—The Canfield pond outlet, side view.

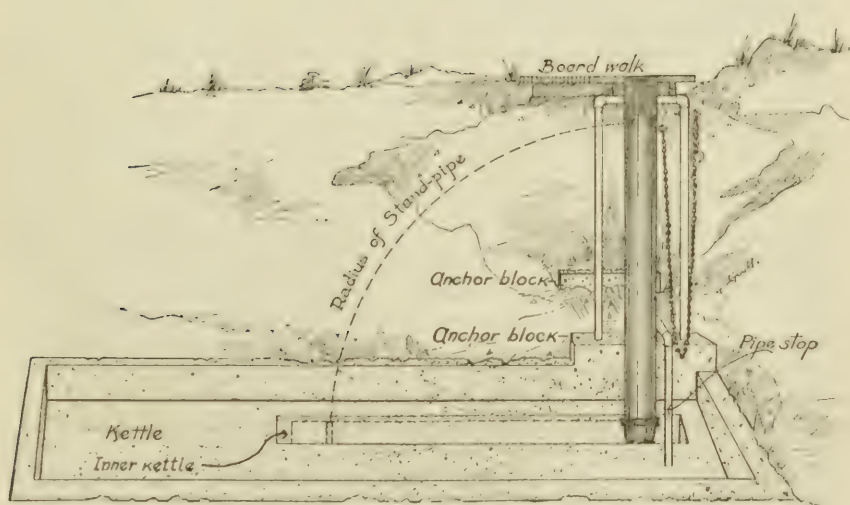


FIG. 2.—The Canfield pond outlet, end view.

It is well to paint the pipes with waterproof paint, and a mixture of graphite and oil is recommended for use in the elbow and coupling threads. Pipe threads should penetrate elbow 1 inch, hand screwed. When the drainage line is to be of terra cotta its joints should be sealed with cement throughout the line rather than laid partly open, as is sometimes done.

The elbow and two pieces of threaded pipe comprising the outlet proper and modifications as to size and detail of the L outlet and appurtenances may be made to suit requirements and material available. If it is necessary to reduce expense, the kettles may be reduced or omitted entirely, but the installation of a kettle, even though of small size, is recommended because of its usefulness when drawing the pond and sorting the fish. The cement blocks, the chief use of which is to protect the outlet drainage line against water working an opening about it, and which also prevents animals such as crayfish and muskrats following it through the embankment, must not be omitted because without the blocks to protect and stay the drainage line leakage is certain to occur. The depth of these blocks should not be reduced, but in unfavorable soil may be increased to advantage.

All surfaces over which embankments are to be laid should be plowed before the fill is commenced, so that the earth will bind satisfactorily, and all foreign matter such as brush, rock, etc., should be excluded from the fill dirt.

The outlet is placed at the drain point and stayed as described, after which the fill is laid over it, the outlet being ready for service as soon as the fill is started. Pipe 4 to 6 inches in diameter is sufficiently large for ponds of less than 1 acre in area. It is always better to have the outlet pipe too large rather than too small.

Many of the spillways and outlets in general use give more or less trouble through leakage, and those of cement construction often freeze and crack, or settle and crack, causing serious trouble and considerable expense. Many of the outlets in use are built into the embankment, thereby weakening and subjecting the embankment to the danger of washouts. Loss of fishes often arises from screens below the water surface becoming damaged, and many outlets, when the pond is being drawn, have too much suction for the good of the little fish. These and other troubles have been eliminated in the L outlet, some favorable features of which are enumerated below:

The action of the outlet is quick and easy.

Leakage and freezing difficulties have been overcome.

The outlet operating from the surface provides minimum suction, which works to the benefit of small fish.

The screen is visible, therefore safe, and easily cleaned.

The outlet does not weaken the pond embankment.

The outlet may be assembled, installed, and maintained at low cost, and is so simple of construction that any "handy man" can build and install it.

ERADICATION OF SOME OBJECTIONABLE PLANTS.

The rank growth of cat-tails in ponds and lakes, particularly at fish-cultural stations, has often become a serious nuisance, causing a substantial reduction in the effective area of the pond. Hitherto there has been no inexpensive or practicable method of combating them, since removal by cutting alone is quite ineffectual. Superintendent Canfield has devised and demonstrated the efficacy of a method of elimination of these plants, based upon the necessity of aeration through contact of the plant or its landward roots with the air.

The water level in the pond is lowered below the limit of growth of the cat-tails, which should then be mowed as low as practicable. With spade or plow a ditch is made below the normal water line and between the cat-tails and the shore. The ditch must be sufficiently deep to sever the roots that connect the plants in the pond with the shore or with any plants that are allowed to remain above the ditch. In this way the air supply from the land roots is completely cut off. The pond should then be immediately flooded and the water

level continuously maintained above the stubble for a week or 10 days, when the cat-tails will have been killed out. It is essential to flood the stubble immediately after mowing in order to get ahead of the rapid growth of the cat-tails. If in consequence of stored oxygen in the severed roots a few weakling shoots should appear above the water surface, they should be pulled out; when this is done a few times the plants will not reappear.

STUDIES OF FISH DISEASE.

The position of fish pathologist in the Bureau was vacant during the last half of the fiscal year, the last incumbent having left the service at the end of December after a year's service. Some studies of diseases and parasites were also conducted by other investigators principally in temporary employ.

MORTALITY IN PIKE-PERCH EGGS.

The great losses in the hatching of pike-perch eggs have made this phase of fish culture a ground of repeated inquiry, although as yet no investigation has been carried to a conclusion revealing the exact causes of the high death rate. Further observations during the past fiscal year were made by Dr. Franz Schrader, who inquired into the practices of handling fish and eggs and investigated the actual changes taking place within the abnormally developing eggs. His observations point to the conclusion that the original cause of abnormal development and mortality of eggs is to be sought in physiological injuries sustained by the parent fish while held in captivity before spawn can be taken. The penning of fishes prior to spawning is a practice of long standing in the artificial propagation of pike-perch and other species of fish. Some species withstand the confinement very well, while others manifest such ill-effects as hardening of ovaries, wateriness of milt, and low percentage of hatched fry—in short, degeneration of eggs and sperms. The general inference of the investigator finds some confirmation in the investigations reported in the next paragraph and also in the experiences of several superintendents who have observed that the mortality of pike-perch eggs is proportional to the length of time the fish have been retained in pens, and conversely, that the percentage of hatch is greater in the case of eggs from fish stripped as taken from the nets than in the case of eggs taken from fish that have been held in pens.

ABNORMAL CONDITIONS OF FISH OVARIES.

Dr. Schrader also conducted inquiries into ovarian conditions in fishes with the purpose of throwing light upon various difficulties arising in hatcheries, including the loss of spawning fishes, ovarian diseases, and failure of fertilized eggs to hatch, troubles which possibly have some relation to abnormal conditions of confinement, handling, or stripping. Observations were made upon developing immature eggs of the scup, the retention of eggs beyond the normal period of spawning, the reabsorption of retained eggs, and the hardening of ovaries. Abnormally retained eggs show signs of degeneration in course of one or two weeks. Reabsorption takes

place through invading cells, but is not always successfully accomplished; it apparently makes a demand upon the body of the fish, which, if excessive, may lead to death.

DISEASE OF RESCUED FISH.

Dr. H. S. Davis, temporary investigator at the Fairport biological station, has found that a high mortality may occur among rescued fishes immediately after the handling incident to rescue operations. This heavy death rate is especially characteristic of the crappies, buffalofish, and bluegills, when taken in warm weather, the first-named species being the weakest. While the mortality may be founded in part upon "shock" sustained during the seining and handling operations, it is due more directly to bacterial infection following slight injuries and gaining headway from the weakened condition of the fish. Immersion for one minute in a solution of copper sulphate in 1 to 1,000 dilution reduces the loss among rescued fishes to a minimum.

In certain experiments 75 to 100 per cent of the crappies rescued from inland sloughs and untreated were lost through death. Under similar conditions, except for a one-minute treatment with 1/1,000 copper-sulphate solution after the fish were allowed to remain a short time in fresh clean water, this experimental loss was reduced to 30 or 40 per cent. The necessity and practicability of the treatment depend upon the conditions attending work in particular fields and at particular times. It is believed that frequent tests should be made in connection with rescue operations and the prophylactic measures taken wherever a substantial mortality rate is to be expected. Dipping in a simple disinfectant can not be very expensive and will be worth while if it will increase appreciably the percentage of survivors.

Dr. Davis's experiments not only point out the possibilities of loss and the means of prevention, but they also emphasize the necessity for great care in handling rescued fish. Rough methods, including the throwing of fishes into receptacles and the abrasion of the fishes' bodies by seines, hands, or débris are the main causes of a high death rate.

PARASITIC FLATWORMS OF FRESH-WATER FISHES.

The parasitic flatworms which infest the body surface and gills of fishes (ectoparasites) may be more of a nuisance to fish culture in ponds, tanks, or aquaria than those which live within the body of the fish. The endoparasites generally can not complete the life cycle without passing different stages in two or more hosts, which are likely to be animals of widely different groups. Therefore, as regards these parasites, fish can not directly infect fish. With external parasites it is otherwise; there being no alternation of hosts, infection may proceed from fish to fish and thus multiply in such abundance as to cause extreme weakness or death of the fish. Such a parasite is *Gyrodactylus fairporti*, a new species described by Dr. H. J. Van Cleave from bullhead and carp of certain ponds at the Fairport (Iowa) station. These flatworms are very small, usually

less than half a millimeter in length, and so translucent that one may easily overlook them.

Some bullheads removed from a quarry pond near the Mississippi River died within 24 hours after being placed in an aquarium of running water. The early death of these usually most hardy fish could be explained only on the supposition that their vitality had been greatly diminished by the small and abundant trematodes (*Gyrodactylus*) scattered over the entire surface of the body. Possibly many fish in the river are unfavorably affected by these worms.

Dr. Van Cleave found a species of another genus of parasitic flatworms upon the gills of sunfish, black bass, and channel catfish, but it is believed that worms of this genus (*Ancyrocephalus*) do not cause dangerous infestations.

Very little study has been devoted to the ectoparasitic flatworms on this continent, and previously but four species have been reported from fresh-water fishes. Much attention has been given them in connection with fish culture in Europe. Treatments which European writers have recommended are: (1) A one-fourth of 1 per cent solution of salicylic acid, in which the fish remains half an hour (Hülner); and (2) a solution of 1 part of potassium permanganate to 100,000 parts of water. The treatments may require modification for our species of fish and of parasites.

Dr. Van Cleave has also described a new genus of trematodes based upon specimens taken from the white bass, *Morone chrysops*, collected in Iowa, Illinois, and Minnesota. The parasites were found only in the digestive tract and at present are ascribed no economic significance. The parasites are not found in *Morone interrupta*, although that species is a close relative of the white bass. He finds, indeed, that the trematode parasites of the yellow bass are entirely distinct from those of the white bass, although the two related species display marked similarity in range, local preference, feeding habits, and food.

TREATMENT OF ICHTHYOPHITHIRIUS DISEASE.

One of the most troublesome external parasitic affections of fresh-water fishes in aquaria and ponds is due to a microscopic protozoan (*Ichthyophthirius*), which becomes embedded in the skin and sets up a violent irritation. H. L. Canfield, superintendent of fish culture at the Fairport station, who has conducted experiments in the treatment of channel catfish heavily infected with the protozoan parasite, reports that commercial carbonate of soda in the form of sal soda (washing soda) is effective in alleviating the trouble.

Using a receptacle other than metal to hold the solution, 150 g. of sal soda are placed in 4,000 c. c. of water, in which solution the affected fish are dipped. The diseased fish are held in troughs of lively running water, which aids in the treatment and facilitates handling. Before each treatment the fish are forced to the lower half of the trough, where they are separated from the upper half by means of a cross screen. The diseased fish are caught in a hand net, immersed in the solution until they show signs of discomfort (darting about), and then placed in the fresh water at the upper end of the trough. This process is continued until a material reduction in parasites is noticed

(usually about six days), after which the treatment is given once a day for about 10 days, which is usually sufficient to rid the fish of the parasites.

The effect of the sal-soda solution is to cause the parasites to shrink and wrinkle as they die. It is apparent that the solution kills the free swimmers, the young just attached to the fish, and all but the larger and more thoroughly embedded parasites. These last leave the fish in the natural process of development, and their offspring are killed with others after they attack the fish and before they attain their maturity. Thus in time the parasites are entirely exterminated.

The channel catfish were fed, as usual, ground liver three times a day while the treatment was in progress, and the usual care was given the fish and troughs as to cleanliness.

OCEANOGRAPHIC AND LIMNOLOGICAL STUDIES.

INVESTIGATIONS IN THE ATLANTIC.

Because of deficiency in funds and personnel the *Albatross* has not been at sea during the year.

Some brief cruises to complete the field work of the hydrographic and biological survey of the Gulf of Maine were made by the small Fisheries steamer *Halegon* under the direction of Dr. H. B. Bigelow. The preparation of the report upon all the data gathered at different times during a period of years is now in progress, although its completion has been delayed by the death of William W. Welsh, who was giving special attention to the portion of the report dealing with the occurrence, distribution, and life histories of the fishes.

By joint action of the Governments of the United States, Canada, and Newfoundland there has been formed during the year an International Committee on Marine Fishery Investigations, with the object of bringing about a better correlation of the activities of the several Governments in fishery investigations in which two or more of the countries are directly interested. Knowledge of the cod and the conditions of its perpetual conservation, for example, possesses the same interest to Canada and Newfoundland as to the United States. No formal cooperative effort is contemplated, but it is believed that progress will be attained more rapidly and economically by regular interchange of data and counsel than by entirely detached endeavor on the part of each nation. The members of the committee are as follows: For Canada, Mr. William A. Fount, Assistant Deputy Minister of Fisheries; Dr. A. G. Huntsman, member of the Biological Board of Canada, and Mr. Loring C. Christie, legal adviser, Department of External Affairs, Ottawa; for Newfoundland, Mr. D. James Davies, chemist to the Newfoundland Government; for the United States, Dr. H. F. Moore, Deputy Commissioner of Fisheries, Dr. R. E. Coker, assistant in charge, scientific inquiry, Bureau of Fisheries, and Dr. H. B. Bigelow, consulting oceanographer, Bureau of Fisheries.

The first meeting of the committee was held in Montreal, June 23, 1920, when, after full discussion, agreement was reached as to correlation and interchange of statistical data with regard to particular fishes, uniformity in methods of plankton study, and concentration of attention upon certain species.

SURVEY OF CHESAPEAKE BAY.

The biological and hydrographic survey of Chesapeake Bay has been continued by Dr. R. P. Cowles, temporary investigator, during the past year, and a large series of data on salinity, temperature, current velocity, and current direction has been accumulated, together with qualitative and quantitative collections of plankton, bottom samples, and many specimens of the larger animals and plants. The observations made and samples collected have not been confined merely to the surface nor to the bottom but have been obtained at definite depths, equal intervals apart, from the surface to the bottom. Probably the most valuable characteristic of the work is the fact that the observations have been made about every sixth week during the year at fixed stations arranged in lines across the bay, these lines being so placed as to adequately cover the bay from the region of Baltimore to the Capes. The Fisheries steamer *Fish Hawk* has been employed in the work on the bay.

During the year preliminary work has been undertaken to determine the hydrogen ion concentration of the sea water by colorimetry. This method has now been perfected, and the tests made on the so-called 24-hour stations, where observations are taken every 1½ hours at definite intervals from the surface to the bottom for a period of 24 hours, have shown some very interesting conditions.

The coming year will be devoted to working over the data and material, with possibly an occasional cruise on the bay to collect information that may be lacking. The general purpose of the investigation is to gather and record the data that are necessary for the interpretation of the seasonal and irregular movements of fishes, for the solution of practical problems that arise from time to time regarding fish and shellfish, and for the conservation and development of the important fisheries of the bay.

This general survey is being supplemented by a special investigation of fishes of the Chesapeake Bay, conducted by S. F. Hildebrand and W. C. Schroeder. While many fishes, especially the younger examples of several species, have been collected in connection with the general survey, the supplemental field work on fishes was undertaken only in the last months of the fiscal year.

SURVEY OF SELECTED AREAS IN MISSISSIPPI RIVER.

In an investigation to determine the distribution of fresh-water mussels, Dr. A. D. Howard made a somewhat detailed study of the entire bottom in a portion of the Mississippi River, the area selected being 3 miles in length and situated in Andalusia Chute, one of the channels of the river in the vicinity of Fairport, Iowa. The river in this section is comparatively straight and of rather uniform character as to gradient and depth, passing over soil of clay, sand, and sedimentary rock (mostly limestone).

The life on the bottom was found to have a rather definite distribution with reference to physiographic features of the river. In general it was restricted to a zone 200 feet wide along each shore. Where islands occurred a narrower zone was found along the shores of the islands. The distribution had apparently no particular relation to depth of water, for the middle area of the stream (about 500

feet wide) was not deeper than the 200-foot strips alongshore. The zones near shore are by no means equally productive throughout, the more densely populated portions manifesting definite relations to the position of the channel and to other features of the stream, especially those that affect the stability of the bottom. Productive areas usually occur in parts of the shore strips that are bathed by the current, or where the channel approaches the shore. Character of bottom soil is a significant feature, but this is often controlled by current, topography, and other conditions.

Keokuk Lake, formed in the Mississippi River above the dam at Keokuk, has been examined some years after its formation to determine some of the effects of the changed conditions. A report of the observations is in process of preparation.

STUDIES OF INLAND LAKES.

The Bureau has continued to cooperate with the Geological and Natural History Survey of Wisconsin in biological and chemical investigations directed at the fundamental problems of the capacity of inclosed waters for support of fish life. As has hitherto been stated, the Bureau bears only a relatively small proportion of the expense of the investigation. Substantial progress has been made, as is indicated by the following outline submitted by President Edward A. Birge and Chancey Juday representing the State Survey:

1. The bulletin dealing with the quantity and chemical composition of the plankton of the lakes situated in the vicinity of Madison is now ready for the press. During this investigation 481 observations have been made on the net plankton and 182 on the nanoplankton of these lakes, making a total of 663 catches. These catches were combined into 374 samples for the chemical analyses. About 2,500 separate chemical and ash determinations have been made on these samples and 52 samples of special material obtained during the progress of this work.

The quantity of dry organic matter in the total plankton of Lake Mendota (net plankton plus nanoplankton) varied from a minimum of 230 pounds per acre in February to a maximum of 521 pounds per acre in December in the area situated within the 20-meter contour line. When the surface of the entire lake and the volume are taken into account the range is from 126 pounds per acre in February to 256 pounds in December. The live weight of the organic matter is 10 times as much as the dry weight.

Of the dry organic matter an average of 44.5 per cent consisted of crude protein, 7.5 per cent ether extract, and 5.3 per cent crude fiber, leaving 42.7 per cent to be designated as nitrogen free extract (chiefly carbohydrates). The pentosans were the only carbohydrates studied, and they constituted an average of 4.6 per cent of the organic matter.

Lakes Monona and Waubesa yielded larger quantities of total plankton. The amount in the former varied from a minimum of 276 pounds per acre in July to a maximum of 1,063 pounds of dry organic matter in October in the area bounded by the 20-meter contour. For the entire lake the range was from 111 pounds to 426 pounds per acre of surface. The maximum crop of plankton in Lake Waubesa yielded 862 pounds of dry organic matter per acre in the area bounded by the 10-meter contour, or 415 pounds per acre for the entire lake; the average for 16 samples is 216 pounds of dry organic matter per acre.

The dry organic matter in the total plankton of Lake Monona contained 57.5 per cent of crude protein, 4.8 per cent of ether extract, 4.7 per cent of pentosans, and 4.4 per cent of crude fiber. The total plankton of Lake Waubesa yielded an average of 48.6 per cent of crude protein, 4.6 per cent of ether extract, 5.8 per cent of pentosans, and 4.4 per cent of crude fiber.

2. Mr. Wilson's numerical results for the bacteria of Lake Mendota show that the average number from surface to bottom in 23.5 meters of water was 3,000 per c. c. of water in July and August, 1919; in the following autumn and

winter the number fell to 1,500 per c. c. In the spring and early summer of 1920 the number rose steadily to a maximum average of about 30,000 per c. c. from the latter part of June to the end of August. During the autumn and early winter the number gradually declined to an average of 2,000 bacteria per c. c. of water.

Many of the bacteria represent chromogenic forms, and various colors are found in the plate cultures. There seem to be some denitrifying individuals present, but conclusive evidence of the presence of lime-precipitating forms has not been obtained yet. The average size of these bacteria has been obtained so that it will be possible to estimate their live weight and dry weight as well as the organic matter in them.

3. Several reports are now in press in the Transactions of the Wisconsin Academy which deal with investigations in which the Bureau of Fisheries has cooperated. The following may be listed here: "A survey of the larger aquatic plants of Lake Mendota," by R. H. Denniston; "A quantitative study of the larger aquatic plants of Lake Mendota," by H. W. Rickett; "A quantitative study of the bottom fauna in the deeper water of Lake Mendota," by C. Juday.

Some chemical analyses of the larger aquatic plants from Lake Mendota have also been made, but this has been done independently by the Wisconsin Survey.

4. Various analyses have shown that the quantity of organic nitrogen in the lake water itself amounts to five or six times as much as that in the total plankton, and Dr. Schuette has been trying to work out a method for the determination of this dissolved organic nitrogen which will give results that are more satisfactory than the present methods of nitrogen determination. The quantities are so small that the methods now used by chemists do not always give consistent results. So far no other method has been found which will give better results than the standard methods.

AGAR-AGAR AND OTHER GELATINS FROM SEAWEED.

It is obviously unfortunate that the United States should be dependent upon other countries for its supply of a vital necessity. Agar-agar is the commercial name applied to a gelatinous product which has been imported from Japan, China, and other places, the importations in 1919 amounting to nearly half a million dollars. The importance of the material is not, however, measured by its strictly commercial value. While it is used in making food and confections, agar-agar is primarily important because it is a necessary medium for bacteriological work, and is therefore essential to medical laboratories and hospitals. It is a requisite for certain industries, for the maintenance of health, and for national security.

Marine algae or seaweed have long been used in this country for the preparation of gelatins for particular purposes, but only the recent investigations, conducted for the Bureau by Dr. Irving A. Field,⁹ have revealed the fact that we have possible sources of supply for the most valuable gelatin of all in certain species of seaweed on the west coast. In the report for the preceding year reference was made to Dr. Field's preparation of a gelatin suitable for use in preserving fish, and to experiments in producing a substitute for agar from Atlantic coast seaweed. These experiments were not successful, but it was later ascertained that at least one species of the west coast yields agar of the best quality. Agar prepared by Dr. Field and tested at the Army Medical School in Washington was pronounced equal or superior to the imported agar. Another species yielded a product apparently of like quality. The investigation should be followed by a field survey for the purpose of definitely locating the

⁹ Field, I. A.: Sources, Preparation, and Properties of Some Algal Gelatines. Bureau of Fisheries, Economic Circular No. 51, issued Oct. 10, 1921, 7 p. Washington.

sources of supply. It was a serious misfortune that Dr. Field died shortly after completing and reporting upon his laboratory investigations.

THE OYSTER.

INVESTIGATIONS OF OYSTER CULTURE.

The investigation of oyster problems of Great South Bay and Long Island Sound was continued according to the general plan of the year before. The work was begun by Dr. E. P. Churchill, assisted by J. S. Gutsell, but Dr. Churchill left the service in August and thereafter Mr. Gutsell continued it alone. Quantitative collections and studies were made with the aid of the pumping equipment and selective screens developed by the Bureau investigators.

At Great South Bay the plan comprised chiefly an intensive study of the distribution, life, and setting of the oyster larvæ. At fixed stations located over a considerable area of the best oyster grounds in the bay quantitative collections were made as in 1919. In that year it had been found that certain of these stations were almost uniformly superior to others in their yield of larvæ, and that the set at these stations was correspondingly more abundant. The work in 1920 was planned to check up and enlarge on this evidence, to see if the general distribution of larvæ was much the same year after year. Addition to our knowledge in other aspects was, of course, to be included.

Unfortunately the season was a poor one. Oyster larvæ until after mid-July occurred scatteringly, at best in small numbers. The conditions indicated a very light set indeed. The one station which showed decided superiority was not located over oyster beds and offered no opportunity of determining a set. A return visit with inadequate apparatus late in August showed young oyster larvæ in apparently fair abundance and indicated an unusually late spawning and a possible late set.

In accordance with the scarcity of larvæ, a very light set was found in the fall; and corresponding apparently to the late spawning, a set was found in the spring which had not attained sufficient size in the fall to be noticeable. In general these sets were so light as to be commercial only to the extent of having sufficient value to repay shifting.

Thus support was given the hypothesis that a relation can be found between the observable abundance of larvæ and the amount of set, and that consequently a scarcity of larvæ indicates that the great expense of "shelling" should be avoided.

In Long Island Sound, where the oysters spawn later than in Great South Bay, the work was curtailed by the reduced personnel and was limited chiefly to the region between Milford and Bridgeport. Collecting was poor indeed except for a time in August, when moderate numbers of larvæ were obtained, particularly about Bridgeport. Something of a set was later reported there. Thus in the Sound, as in Great South Bay, there was little opportunity that season to obtain other than negative evidence as to the relation of the occurrence of oyster larvæ and the abundance and location of set.

The study, made in cooperation with the Bureau of Chemistry, of the trade-waste problem in its relation to oyster culture was continued. Before he left the Bureau Dr. Churchill performed experiments with various dilutions of standard solutions of chemicals known to occur in or to be discharged into water near oyster beds. He found the larvæ very sensitive, certain chemicals being fatal even in great dilutions. In Bridgeport Harbor late in the season samples were collected for the determination of the distribution of injurious wastes, particularly the heavy metals. As a result of the study of this harbor and of the efforts of the two bureaus, the company, which discharged much of the greatest amounts of copper, was persuaded to install an electrolytic recovery process, which has given great promise both as a money saver and as a means of improving harbor conditions.

In June, 1921, the spawning of oysters in Great South Bay has been found to begin in earnest almost a month earlier than in previous years of our experience and to occur at decidedly lower temperatures. The work is being so carried on as to check up the data obtained in 1919, and already the larvæ have been found to be much more widely distributed in good numbers. In addition, as opportunity permits, data are being gathered to test out the hypothesis advanced by Dr. T. C. Nelson that oyster larvæ of the larger sizes keep from being washed to sea by sinking with the ebb tide and rising with the flood.

The study of the development and distribution of the larvæ is of interest to local oystermen and has, it is believed, influenced them in determining the times, places, and extent of planting shells for set. The immediate purpose of the Bureau, it must be understood, is to determine the possibilities of the method of larvæ survey in obtaining best results and effecting economies in planting and in the prevention of costly wastes from planting in seasons when a set is not obtainable. Once a satisfactory demonstration is obtained, the method can be applied in other localities as well as at the places where the experiments have been conducted.

EFFECT OF POLLUTIONS UPON PROPAGATION OF OYSTERS.

Pollutions may affect oyster eggs and larvæ, either directly, by the toxic effect of certain chemicals upon the young oysters, or indirectly, through the exhaustion of the oxygen supply and partial or complete suffocation of the larvæ. The latter aspect of the problem was given attention by Dr. P. H. Mitchell, director of the Woods Hole (Mass.) Fisheries laboratory.

In experiments on the effect of oxygen deprivation on oyster larvæ Dr. Mitchell found that while the embryos are sensitive to diminished oxygen supply a number of factors affect the lower limit of the oxygen content of water compatible with life of the larvæ. The factors noted were: (*a*) The previous history of the eggs from which the larvæ were hatched, for example, ripeness at the time of artificial fertilization and previous exposure to pollution; (*b*) the age of the larvæ; (*c*) the carbon-dioxide content of the water; (*d*) the hydrogen ion concentration of the water; and (*e*) the temperature.

Development of a satisfactory technique for handling such unusually sensitive and perishable material as oyster larvæ, in the

manipulations required for this experiment, consumed much time. Consequently the end of the breeding season for oysters came before there was opportunity to work out the relations of all these factors in an entirely quantitative manner.

Results may be summarized as follows:

With regard to the condition of the eggs, it was observed that embryos from eggs of which 50 per cent or more developed quickly to a free swimming stage withstood deprivation of oxygen better than those from eggs of which only a small proportion developed.

With respect to age, it appeared that younger larvæ endured comparative oxygen deprivation slightly longer than older ones, but the experiments were not conclusive.

It was found that embryos show some effect of oxygen lack in water containing 25 per cent of saturation of oxygen at 24° C. and a markedly increased mortality in 10 per cent of saturation. Killing time varied from 12 to 30 hours according to extent of oxygen depletion. At 28 to 30° C. embryos die much more rapidly from oxygen starvation than at 22 to 24° C.

Carbon dioxide seems to have a toxic effect other than that due to hydrogen ion concentration. Embryos died earlier in water containing sufficient oxygen but excessive CO₂ than in water of the same oxygen content and with the same P_H obtained by adding lactic acid.

Investigation of the effect of pollution on satisfactory development of eggs in gonads was also conducted. Results showed that from oysters, kept 7 to 10 days in water polluted so as to markedly lower its oxygen content, only an abnormally small proportion of eggs could be made to develop after artificial fertilization, conducted according to standardized technique, and that the embryos so obtained did not develop as far as controls.

An incidental observation proved of considerable interest. Oysters which had been in cold storage 24 days for the purpose of studying greening were found to have very full gonads. Eggs fertilized with sperm from some of the same lot of oysters developed satisfactorily, and many of the embryos reached the primitive shell stage. Some of them, indeed, were used in oxygen-requirement tests.

Observations on the cause of copper greening confirmed previous conclusions by showing that not only the amount of copper obtainable by the oysters, but also conditions of habitat determine whether or not visible green spots occur. Marked appearance of greenness after one or more weeks in cold storage was observed. It has been twice noted that with gonads filled a smaller proportion of oysters become green during storage than in other conditions. Two-year-old spent oysters, set and reared in Wareham River, did not become green during four weeks in cold storage. This is in contrast to oysters which at some time during their previous history have been in waters known to produce greenness (near Bridgeport and New Haven).

Experiments both in the laboratory and in the field indicated a positive influence of diminished oxygen supply in causing the appearance of green spots. Repeated observations of marked greening of oysters in polluted tanks of sea water were also made, thus confirming the similar results obtained during the previous summer in the Seekonk River.

FRESH-WATER MUSSELS.

PROPAGATION OF MUSSELS.

The Fisheries biological station at Fairport, Iowa, continued its practical propagation of fresh-water mussels in the Mississippi drainage at Lake Pepin and Lake Pokegama, Minn.; at New Boston, Oquawka, and Dallas City, Ill.; at Fairport, Iowa; at Hannibal and Clarksville, Mo.; and in cooperation with rescue crews along the Mississippi in Wisconsin and Minnesota. The total number of glochidia infected upon fish and liberated in public waters during the year was approximately 648,445,000, including 478,705,000 infected upon rescued fish by cooperative agents working in connection with rescue crews of the division of fish culture.

With a view to demonstrating the possibilities of mussel propagation in connection with the rescuing of food fishes, the National Association of Button Manufacturers offered to cooperate with the Bureau by providing men to accompany each rescue crew on the upper river and to inoculate all fishes with the glochidia of the Lake Pepin mucket, the most important of the local mussels. Seven agents of the button manufacturers cooperated with seven crews working under the direction of Supt. Culler, of the Homer (Minn.) station, and during October and November inoculated nearly 6,000,000 fish with glochidia.

The localities in which the work was done and the number of fish subjected to infection in each locality were as follows:

| | |
|---------------------------|-------------|
| Lynxville, Wis..... | 2, 025, 200 |
| Genoa, Wis..... | 1, 214, 900 |
| Ferryville, Wis..... | 907, 340 |
| Fountain City, Wis..... | 86, 510 |
| North McGregor, Iowa..... | 676, 100 |
| Bellevue, Iowa..... | 931, 500 |
| Total..... | 5, 841, 550 |

Material cooperation of this nature by an association of business men is a source of gratification to the Bureau, not only as evidence of a cordial spirit, but as evidence of faith in the practical value of the service rendered in the propagation of river mussels.

PROTECTION OF MUSSELS.

A prominent feature of the work of the Fairport station for several years has been the part which it has played in bringing about a strong sentiment for the protection of fresh-water mussels and the cooperation it has extended to the several States in giving aid, when solicited, in selecting the areas for closure to mussel fishing. Additional closures of streams or parts of streams has followed the beginning made in the past by Minnesota and Wisconsin. Minnesota in April closed for a period of five years parts of the Minnesota River, and the entire Cannon and Straight Rivers. Iowa, in the same month, closed for a similar period parts of the Iowa, Cedar, and Des Moines Rivers, and the entire Shellrock River.

MUSSEL SURVEY IN UPPER MISSISSIPPI RIVER.

During the months of July and August, 1920, the Bureau of Fisheries made a study and appraisal of the mussel resources in a portion of the upper Mississippi River, beginning at a point about 5 miles above Red Wing, Minn., and extending down through Lake Pepin, a distance of about 80 miles, to Lamoille, Minn. The work was undertaken with reference to recent administrative action on the part of the States of Wisconsin and Minnesota providing for the closure of certain areas for the protection of the fresh-water mussels while permitting the fishery to continue in alternate open areas. The data acquired in this investigation are expected to establish a basis for comparison of conditions before and after a period of protection. The investigation was conducted under the Fairport biological station by Dr. N. M. Grier, with two assistants. Observations were made in five open and five closed areas.

Many data were secured regarding the depletion of formerly productive areas of mussel fishery, the diminution in abundance of mussels in different beds being attributed variously to the indirect effects of the construction of wing dams as aids to navigation, to excessive fishery, and perhaps in some cases to the dumping of rubbish in the river in the vicinity of cities.

The information gained will serve also as an aid to the Bureau in the conduct of mussel propagation for the rehabilitation of depleted and protected areas.

EXPERIMENTS RELATING TO MUSSEL PROPAGATION.

Experiments in retaining in inclosures fish artificially infected with glochidia of the Lake Pepin mucket, *Lampsilis luteola*, have been continued in Lake Pepin by Roy S. Corwin, scientific assistant. It was found in certain experiments that pike perch infected as late as August 19 carried glochidia until the following May, and that mussels during the second year of growth will thrive in an inclosure with a density of 18 mussels to the square foot. Third-year mussels with eight to the square foot flourished and showed an average increase in length of more than 100 per cent in one year.

Artificial infections of the Lake Pepin mucket on pike perch retained in a fine-meshed inclosure in the lake yielded an average of 833 juvenile mussels per fish. Assuming that these fish bore the usual infection of about 3,000 glochidia per fish, the yield of young mussels was 27.4 per cent. This is a much higher percentage than has ever been assumed to result from practical operations in artificial propagation of mussels.

Dr. L. B. Arey continued his study of the encystment of the glochidia of the fresh-water mussel. It has been established that the tactile response of the glochidium alone is adequate to insure attachment. The view that glochidia regularly attached to the host through a chemical activation by blood, derived from gill hemorrhages, appears to be untenable. Cyst formation is not initiated or controlled by any vital influence of the glochidium. It has been induced by the application of tiny metallic clips to a gill filament.

INVESTIGATIONS IN THE KENTUCKY RIVER.

Prior to 1919 the Kentucky River was an unworked and practically unknown mussel stream. In the summer and autumn of 1919 and the summer of 1920 the upper part of the river was investigated by Ernest Danglade, temporary assistant. Preliminary tests were made in the summer of 1919 which indicated that good marketable shells were to be found in the headwaters, and encouragement was offered to various people who had expressed a desire to engage in mussel fishing. As a result, by the middle of July, 1919, two mussel camps were established in the upper courses.

The river was examined from near its source down to Beattyville, Ky., below which place the stream contains many locks and dams and is unsuitable for mussel fishing. In the upper parts of the stream, in the north and middle forks, numerous but small beds were encountered. Fourteen were investigated and are described in some detail in a report on file with the Bureau. Forty species of mussels were obtained, of which 22 have commercial value, the mucket being the most important. Upper Twin Shoals is remarkable for the abundance of young muckets.

THE BIOLOGICAL LABORATORIES.

The Woods Hole (Mass.) laboratory, Dr. P. H. Mitchell, director, was in operation with a limited staff during the summer of 1920. Previous mention has been made of the investigation relating to oysters and the preparation of commercial gelatins from seaweeds. Prof. Edwin Linton continued investigations of the food and parasites of fishes, and Prof. William W. Browne was engaged in completing his report upon the nature and causes of the reddening of salt fish. Because of the unavoidable limitation of the Bureau's activities, it was found impracticable to open the laboratory for the summer of 1921.

Beaufort (N. C.) laboratory has been virtually closed during nearly the entire fiscal year. Since the director, R. L. Barney, was necessarily transferred early in the year to another station, the laboratory has been without scientific direction. Mr. Barney has, however, completed a general report on the natural history and culture of the diamond-back terrapin, embodying the information available from observations and experiments as relating to growth and reproduction of wild and domestic stock, care of young and adults, feeding, housing, and hybridization. Further attention has been given to the study of the bacterial disease which has been the only serious disease affecting winter-fed terrapin. Under the superintendence of Charles Hatsel, terrapin experiments have been continued, the grounds of the station have been kept in good condition, and the buildings in such repair as was possible with the available funds.

At the Fairport (Iowa) biological station the new laboratory building was completed and occupied early in September, and shortly thereafter R. L. Barney was appointed director of the station. In response to an outside demand, the laboratory building was formally dedicated October 7. A large number of prominent persons, including scientists representing the leading universities of the country,

participated both in the exercises of dedication and in the conference on the following day, which gave consideration to the natural resources of interior waters and the possibilities of their utilization and conservation.

The interest manifested in that conference and the demonstration it afforded of the possibility of bringing about better cooperation in the conservation of aquatic resources led to a call by the Secretary of Commerce of a conference of more extended duration to meet at the station June 8 to 10, 1921. On this occasion there were in attendance about 125 persons, including biologists, chemists, sanitarians, fishermen, manufacturers, fish-culturists, game wardens, engineers, and others. During the three days of the conference there was free and informal discussion related to the three major topics suggested in the call for the gathering, viz: The depletion of aquatic resources, causes, and remedial measures; the value of swamp and shore areas and their best utilization; and a constructive program of conservation. Interest was sustained throughout, and the conference adjourned only after recording a request that a similar meeting be called the following year.

The special activities of the Fairport station have been treated under several preceding heads: investigation of the paddlefish, fish-cultural experiment work, studies of fish disease, survey of selected areas in the Mississippi River, and fresh-water mussels. The station frequently also performs services of value to fishing clubs, private hatcheries, and individual owners of lakes and ponds, furnishing advice regarding the stocking and control of ponds and aiding in the solution of such troublesome conditions as may arise. The value of these advisory services is founded upon the scientific research conducted at the station and the experience gained in propagating and rearing fish under conditions of control.

The Key West (Fla.) biological station has been without a director from the beginning of the fiscal year until within a few days of the close of the year, when the services of a competent scientist were secured for a temporary period. During the greater part of the year the station has been in the hands of a caretaker. No further constructions have been undertaken, but the grounds have been suitably fenced for protection, and some plantings of appropriate vegetation have been made.



PROPAGATION AND DISTRIBUTION OF FOOD FISHES, 1921.

REPORT OF THE DIVISION OF FISH CULTURE FOR THE FISCAL YEAR 1921.¹

By GLEN C. LEACH, *Assistant in Charge of Fish Culture.*

CONTENTS.

| | Page. | Part 1—Continued. | Page. |
|--|-------|------------------------------------|-------|
| Introduction..... | 2 | Propagation of commercial fishes— | |
| Part 1.—Fish propagation and rescue..... | 4 | Continued. | |
| Summary of operations..... | 4 | Propagation of yellow perch, | |
| Species of fishes handled..... | 4 | Bryans Point (Md.) station..... | 37 |
| Summary of output..... | 5 | Marine fish culture..... | 37 |
| Summary of egg collections..... | 5 | Boothbay Harbor (Me.) sta- | |
| Summary of fish-rescue work..... | 7 | tion..... | 38 |
| Stations and substations operated | | Gloucester (Mass.) station..... | 38 |
| and output of each..... | 8 | Woods Hole (Mass.) station..... | 40 |
| Egg-collecting or auxiliary sta- | | Propagation of buffalofish, Atcha- | |
| tions..... | 13 | falaya (La.) substation..... | 41 |
| Transfers of eggs..... | 15 | Propagation of anadromous fishes | |
| Propagation of commercial fishes..... | 16 | of Atlantic coastal streams..... | 42 |
| Pacific salmon culture..... | 16 | Propagation of shad, Bryans | |
| Afognak (Alaska) station..... | 16 | Point (Md.) and Edenton | |
| Yes Bay (Alaska) station..... | 17 | (N. C.) stations..... | 42 |
| Baker Lake (Wash.) station | | Propagation of glut herring, | |
| and substations..... | 18 | Edenton (N. C.) station..... | 44 |
| Baker Lake (Wash.) station..... | 18 | Propagation of alewife, Booth- | |
| Birdsview (Wash.) substa- | | bay Harbor (Me.) station..... | 45 |
| tion..... | 19 | Propagation of striped bass, | |
| Brinnon, Duckabush, and | | Weldon (N. C.) substation..... | 45 |
| Quilcene (Wash.) substa- | | Propagation of Atlantic salmon, | |
| tions..... | 19 | Craig Brook (Me.) station..... | 45 |
| Quinault (Wash.) substation..... | 20 | Propagation of fishes of interior | |
| Sultan (Wash.) substation..... | 22 | waters..... | 46 |
| Clackamas (Oreg.) station and | | New England salmon and trout | |
| substations..... | 23 | stations..... | 47 |
| Clackamas (Oreg.) station..... | 23 | Berkshire (Mass.) station..... | 47 |
| Upper Clackamas (Oreg.) sub- | | Craig Brook (Me.) station..... | 48 |
| station..... | 24 | Green Lake (Me.) station and | |
| Little White Salmon and Big | | substation..... | 48 |
| White Salmon (Wash.) sub- | | Nashua (N. H.) station..... | 50 |
| stations..... | 24 | St. Johnsbury (Vt.) station..... | 50 |
| Rogue River (Oreg.) substa- | | Rocky Mountain trout stations..... | 52 |
| tion..... | 24 | Bozeman (Mont.) station and | |
| Applegate (Oreg.) substation..... | 25 | substations..... | 52 |
| Washougal River (Wash.) | | Bozeman (Mont.) station..... | 52 |
| substation..... | 25 | Meadow Creek (Mont.) aux- | |
| Salmon (Idaho) substation..... | 25 | iliary station..... | 52 |
| Baird (Calif.) station and sub- | | Yellowstone Park (Wyo.) sub- | |
| stations..... | 26 | station..... | 53 |
| Investigations and experiments..... | 27 | Glacier Park (Mont.) sub- | |
| Fertilization of salmon eggs | | station..... | 53 |
| in natural spawning..... | 27 | Leadville (Colo.) station..... | 53 |
| Hatching eggs in gravel..... | 29 | Saratoga (Wyo.) station..... | 54 |
| Suggestions for possible im- | | Spearfish (S. Dak.) station..... | 55 |
| provement and enlargement | | Springville (Utah) station and | |
| of work..... | 29 | substation..... | 55 |
| Propagation of fishes of the Great | | Combination trout and pond fish- | |
| Lakes..... | 31 | cultural stations..... | 56 |
| Duluth (Minn.) station..... | 33 | Erwin (Tenn.) station..... | 57 |
| Northville (Mich.) station and | | Manchester (Iowa) station..... | 58 |
| substations..... | 33 | Neosho (Mo.) station..... | 58 |
| Put In Bay (Ohio) station..... | 34 | White Sulphur Springs (W. | |
| Cape Vincent (N. Y.) station..... | 35 | Va.) station..... | 60 |
| Swanton (Vt.) substation..... | 36 | Wytheville (Va.) station..... | 60 |

¹ Appendix IX to the Report of the United States Commissioner of Fisheries for 1921.
B. F. Doc. No. 912.

| Part 1—Continued. | Page. | Part 1—Continued. | Page. |
|--|-------|--|-------|
| Propagation of fishes of interior waters—Continued. | | Rescue operations----- | 78 |
| Work of pond fish-cultural stations----- | 61 | Outline of possible extension----- | 78 |
| Summary of output----- | 62 | Methods employed in rescuing fish----- | 80 |
| Cold Springs (Ga.) station----- | 63 | Review of the work----- | 80 |
| Edenton (N. C.) station----- | 63 | Part 2.—Distribution of fish and fish eggs----- | 81 |
| Louisville (Ky.) station----- | 64 | Extent and character of the work----- | 81 |
| Mammoth Spring (Ark.) station----- | 64 | Brief review of the work----- | 81 |
| Orangeburg (S. C.) station----- | 65 | Summary of distribution to all applicants----- | 82 |
| San Marcos (Tex.) station----- | 65 | Assignments to State fish commissions----- | 86 |
| Tupelo (Miss.) station----- | 66 | Considerations in distribution of commercial fishes----- | 87 |
| Practical devices for use in pond fish culture----- | 66 | Results of planting fishes in interior waters----- | 88 |
| A practical system of cleaning fish ponds----- | 66 | Distribution costs and equipment----- | 90 |
| Pond outlet and "kettle"----- | 68 | Cost of distribution----- | 90 |
| Specifications----- | 69 | Distribution cars----- | 90 |
| Modified form of pond outlet----- | 70 | Pocket thermometer for use in carrying live fish----- | 91 |
| Work of Central station, Washington, D. C.----- | 70 | Procedure in assignments of fishes to applicants----- | 91 |
| Spawning seasons of fishes handled at stations----- | 72 | Application blanks----- | 91 |
| Fish food used at fish-cultural stations----- | 75 | Selection of species----- | 91 |
| Amount and cost of fish food used----- | 75 | Size of allotments----- | 93 |
| Food for bass----- | 77 | Time and method of delivery----- | 93 |
| Tests with herring milt as food for rainbow trout----- | 77 | | |

INTRODUCTION.

In considering the value of any branch of governmental work it is clearly just to take cognizance of the progress made, as evidenced by an increased volume of work, but improved methods and lower costs of producing and distributing the output are, in the case of fish culture, of more importance, as indicating efficiency and sustained interest in the work.

For a number of years there has been no increase in the funds provided for the propagation and distribution of food fishes, and only the very inadequate increase in compensation of faithful employees as provided by the so-called bonus of \$240 per annum. In the face of this condition and the fact that the cost of all commodities, labor, and railroad rates increased many fold during the period of the World War, it is particularly gratifying to note that the bureau maintained its fish-cultural establishment, if not intact, still at a point of efficiency where it handled an increased volume of work without material increase in the cost of production or distribution.

The value of modern fish culture is so generally accepted by those having knowledge of the facts as to need no defense and is shown by the action of many States in providing funds for such work, by the numbers of fish-cultural plants financed by commercial interests, and by individuals who are interested only in maintaining the fish supply in a given locality.

The bureau's fish-cultural division is probably more completely organized and equipped than any similar institution in the world. It has been built up through a long period of years and represents the thoughtful and painstaking effort of many persons. It has reached a point in its history where its movement must either advance or retrograde. To longer maintain the present magnitude of the work with the funds provided is manifestly impracticable. On the other hand, the opportunities for its continued enlargement and extension are restricted only by the facilities available.

During the fiscal year ended June 30, 1921, 62 per cent of the appropriation provided by Congress for the propagation and distribution of food fishes was expended in the maintenance and development of the commercial fisheries.² The remaining portion of the fund was devoted to the equally important, though less extensive, work of producing and disseminating in the interior waters of the country various species of trout and the so-called warm-water fishes, including the black basses, crappies, and sunfish. The widely extended and rapidly increasing use of the automobile has opened to tourists and sportsmen numerous trout and bass waters which were formerly inaccessible, with the result that interior streams and lakes in all parts of the country have been heavily overfished. Of all fishermen concerned automobilists as a class are perhaps the most law-abiding, but their rapidly increasing numbers and their habit of camping near a promising body of water and fishing it for an extended period—sometimes for several days—has constituted a drain which it will not be easy to make good. A most serious aspect of the situation is that it threatens the resources of waters which have never heretofore required any appreciable effort on the part of either Federal or State agencies to maintain. The greatest danger in this respect lies in the Western mountain States, in New England, and in other parts of the country which abound in natural scenic beauty.

The situation is a grave one, and if not given proper and immediate attention by the States concerned and by the Federal Government there is imminent danger of the total depletion of fish life in many valuable waters which have heretofore yielded an abundant supply. The advantages of keeping the interior waters of the country well stocked with the game and food fishes adapted to them are many and obvious. By such means a cheap and very desirable food supply is afforded to a certain class of people who would otherwise be unable to enjoy it. Vast numbers of people are inspired by the lure of good fishing to seek the great out-of-doors, with very beneficial results to their health, aside from the recreation afforded. Certain of the State authorities who are not able to cope with the difficulty have applied to the Bureau of Fisheries for aid, but in most instances it could not be given, the bureau's resources having been already greatly overtaxed in the effort to maintain the scope of its work along previously established lines.

The bureau's efforts in fish culture are directed chiefly toward the maintenance of the existing fisheries of the country and toward the development of new and profitable sources of fish supply by extending its operations over a wider territory in fields contiguous to the present stations. Five important functions are involved in this work, namely, the collections of eggs from various species of fish of economic value, the incubation of the eggs in properly equipped hatcheries, the rearing and feeding of the young of certain species, the rescue of stranded fishes from overflow waters in the Mississippi Valley, and the distribution of fish and fish eggs in suitable waters.

²The expenditures involved in distributing the output of the hatcheries represents approximately 17 per cent of the total appropriation, and 30 per cent of this amount represents the expenditures in connection with the commercial species.

Part I.—FISH PROPAGATION AND RESCUE.

Summary of Operations.

SPECIES OF FISHES HANDLED.

During the fiscal year ended June 30, 1921, the bureau propagated and distributed some 48 species of fishes, as shown in the following list. Fishes rescued from overflowed lands in the Mississippi Basin and restored to original waters or distributed in other sections of the United States are included.

LIST OF SPECIES HANDLED.

THE CATFISHES (SILURIDÆ):

- Horned pout, bullhead (*Ameiurus nebulosus*).
- Marbled catfish (*Ameiurus nebulosus marmoratus*).
- Mississippi catfish (*Ameiurus lacustris*).
- Spotted catfish, channel catfish (*Ictalurus punctatus*).
- Yellow catfish (*Leptops olivaris*).

THE SUCKERS (CATOSTOMIDÆ):

- Mongrel buffalofish (*Ictiobus urus*).
- Common buffalofish (*Ictiobus cyprinella*).
- Smallmouth buffalofish (*Ictiobus bubalus*).

THE CARPS (CYPRINIDÆ):

- Asiatic carp (*Cyprinus carpio*).

THE SHADS AND HERRINGS (CLUPEIDÆ):

- Shad (*Alosa sapidissima*).
- Glut herring (*Pomolobus aestivalis*).
- Skipjack (*Pomolobus chrysochloris*).

THE SALMONS, TROUTS, WHITEFISHES, ETC. (SALMONIDÆ):

- Common whitefishes (*Coregonus albus* and *C. clupeaformis*).
- Cisco (chiefly *Leucichthys artedi*).
- Chinook salmon, king salmon, quinnat salmon (*Oncorhynchus tshawytscha*).
- Chum salmon, dog salmon (*Oncorhynchus keta*).
- Humpback salmon, pink salmon (*Oncorhynchus gorbuscha*).
- Silver salmon, coho salmon (*Oncorhynchus kisutch*).
- Sockeye salmon, blueback salmon, redfish (*Oncorhynchus nerka*).
- Steelhead salmon (*Salmo gairdneri*).
- Atlantic salmon (*Salmo salar*).
- Landlocked salmon (*Salmo sebago*).
- Rainbow trout (*Salmo shasta*).
- Blackspotted trout, redbthroat trout (*Salmo lewisi*).
- Loch Leven trout (*Salmo levenensis*).
- Lake trout, Mackinaw trout (*Cristivomer namaycush*).
- Brook trout (*Salvelinus fontinalis*).

THE GRAYLINGS (THYMALLIDÆ):

- Montana grayling (*Thymallus montanus*).

THE SMELTS (OSMERIDÆ):

- Smelt (*Osmerus mordax*).

THE PIKES (LUCIDÆ):

- Little pickerel (*Lucius vermiculatus*).
- Common pickerel (*Lucius lucius*).

THE SUNFISHES, BLACK BASSES, AND CRAPPIES (CENTRARCHIDÆ):

- Crappies (*Pomoxis annularis* and *P. sparoides*).
- Largemouth black bass (*Micropterus salmoides*).
- Smallmouth black bass (*Micropterus dolomieu*).
- Rock bass (*Ambloplites rupestris*).
- Warmouth bass, goggle-eye (*Chaenobryttus gulosus*).
- Bluegill sunfish (*Lepomis pallidus*).
- Common sunfish (*Eupomotis gibbosus*).

THE PERCHES (PERCIDÆ):

- Pike perch (*Stizostedion vitreum*).
- Yellow perch (*Perca flavescens*).

THE BASSES (SERRANIDÆ):

Striped bass, rockfish (*Roccus lineatus*).White bass (*Roccus chrysops*).White perch (*Morone americana*).

THE DRUMS (SCAENIDÆ):

Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*).

THE CODS (GADIDÆ):

Cod (*Gadus callarias*).Haddock (*Melanogrammus aeglefinus*).Pollock (*Pollachius virens*).

THE FLOUNDERS (PLEURONECTIDÆ):

Winter flounder, American flatfish (*Pseudopleuronectes americanus*).Pole flounder (*Glyptocephalus cynoglossus*).

SUMMARY OF OUTPUT.

During the fiscal year 1921 the bureau's efforts in fish propagation and rescue of stranded fishes resulted in a gross output of 4,962,583,555 fish and fish eggs for distribution, 93 per cent of which was made up of the important commercial species and 7 per cent of the species used in stocking interior waters. Losses due to transportation amounted to 94,150, making a net product of fish and fish eggs actually distributed of 4,962,489,405. A summary of this net output, shown by species, is given in the following table:

SUMMARY, BY SPECIES, OF NET OUTPUT OF FISH AND FISH EGGS, FISCAL YEAR 1921.

| Species. | Eggs. | Fry. | Fingerlings. | Total. |
|----------------------------|---------------|---------------|--------------|---------------|
| Catfish..... | | | 35,257,070 | 35,257,070 |
| Buffalofish..... | | 108,307,000 | 1,645,835 | 109,952,835 |
| Carp..... | | 106,043,000 | 3,918,580 | 109,961,580 |
| Shad..... | | 32,792,275 | | 32,792,275 |
| Glut herring..... | | 43,815,000 | | 43,815,000 |
| Whitefish..... | 181,650,000 | 288,800,000 | | 420,450,000 |
| Cisco..... | 186,510,000 | 89,800,000 | | 276,310,000 |
| Chinook salmon..... | 6,780,000 | | 32,780,765 | 39,560,765 |
| Chum salmon..... | | 7,000,000 | 19,436,400 | 26,436,400 |
| Silver salmon..... | | 600,000 | 6,486,150 | 7,086,150 |
| Sockeye salmon..... | 350,000 | 38,778,500 | 30,434,500 | 69,563,000 |
| Steelhead salmon..... | 493,000 | 38,810 | 2,928,915 | 3,460,725 |
| Atlantic salmon..... | | 1,387,000 | 280 | 1,387,280 |
| Landlocked salmon..... | 575,000 | 208,115 | 124,250 | 907,365 |
| Rainbow trout..... | 2,553,240 | 414,100 | 3,872,225 | 6,839,565 |
| Blackspotted trout..... | 820,000 | 3,899,100 | 1,000,300 | 5,719,400 |
| Loch Leven trout..... | | | 64,000 | 64,000 |
| Lake trout..... | 2,824,000 | 16,563,300 | 208,500 | 19,595,800 |
| Brook trout..... | 856,890 | 3,642,330 | 7,559,625 | 12,058,845 |
| Grayling..... | | 1,400,000 | | 1,400,000 |
| Smelt..... | 600,000 | 7,000,000 | | 7,600,000 |
| Pike and pickerel..... | | | 540,510 | 540,510 |
| Crappie..... | | | 37,303,000 | 37,303,000 |
| Largemouth black bass..... | | 585,050 | 1,221,005 | 1,806,055 |
| Smallmouth black bass..... | | 303,700 | 54,590 | 358,290 |
| Rock bass..... | | | 108,305 | 108,305 |
| Warmouth bass..... | | | 100 | 100 |
| Sunfish..... | | | 30,371,475 | 30,371,475 |
| Pike perch..... | 200,475,000 | 57,385,000 | 108,515 | 353,968,515 |
| Yellow perch..... | 12,000,000 | 176,369,450 | 6,166,435 | 194,535,885 |
| Striped bass..... | | 20,184,000 | | 20,184,000 |
| White bass..... | | | 27,170 | 27,170 |
| Freshwater drum..... | | | 34,080 | 34,080 |
| Cod..... | 208,800,000 | 175,341,000 | | 384,141,000 |
| Haddock..... | 188,940,000 | 271,880,000 | | 460,820,000 |
| Pollock..... | | 455,066,000 | | 455,066,000 |
| Winter flounder..... | | 1,768,660,000 | | 1,768,660,000 |
| Pole flounder..... | 19,410,000 | | | 19,410,000 |
| Miscellaneous fishes..... | | | 4,935,165 | 4,935,165 |
| Total..... | 1,109,637,130 | 3,626,262,730 | 226,580,545 | 4,962,489,405 |

SUMMARY OF EGG COLLECTIONS.

Eggs are obtained by several methods, but the principal source of supply is the commercial fisheries, where, were it not for the bureau's

activities, vast numbers of eggs would be sent to market in the fish and become a total loss. In the case of certain species, notably but not exclusively the salmon of the Pacific coast, where commercial fishing does not extend to or is not permitted on the spawning areas, employees of the bureau capture the spawning fish either in seines or in traps and artificially incubate in its hatcheries the eggs thus obtained. The object of this work is to bring about a higher percentage of fertility in the eggs than is possible in natural reproduction and to afford the eggs and the resulting young fish protection from their natural enemies. Eggs in appreciable numbers are also obtained from domesticated fish, which are maintained in ponds at fish-cultural stations from year to year under more or less artificial conditions.

A decrease of approximately 121,000,000 in the aggregate egg collections occurred this season as compared with last year, as is indicated by the accompanying table, and the same causes that were operative to the detriment of the work then were again in evidence. However, in any line of enterprise where results are dependent to a large extent upon weather conditions, as is the case in all of our egg-collecting fields, a comparison of one season's work with that of another will indicate a considerable fluctuation in total results, and it is only by comparing the results over a period of years that the actual trend of the work may be traced with any degree of accuracy.

The most noticeable variations in the egg collections of 1921 as compared with 1920 are increased collections of eggs of chum salmon, cisco, rainbow trout, blackspotted trout, whitefish, pike perch, yellow perch, striped bass, carp, haddock, and glut herring, and decreased collections of eggs of the chinook, silver, sockeye, humpback, and steelhead salmon, landlocked salmon, lake and brook trout, shad, buffalofish, cod, pollock, and other species of less importance. It is to be noted that while a decrease occurred in the number of eggs collected during 1921, as compared with the previous year, there was an increase of approximately 179,000,000 in the aggregate output of the stations in eggs, fry, and fingerlings. This apparent discrepancy in figures is accounted for by the better quality of the eggs handled during the year and the higher percentage of fry produced; also to an increase in the numbers of eggs fertilized and planted on the spawning grounds.

COMPARISON OF EGG COLLECTIONS, 1920 AND 1921.

| Species. | Fiscal year 1920 | Fiscal year 1921. | Species. | Fiscal year 1920. | Fiscal year 1921. |
|----------------------|---------------------|----------------------|----------------------|----------------------|----------------------|
| Buffalo fish..... | 236,400,000 | 163,267,000 | Blackspotted trout.. | 2,617,600 | 5,993,600 |
| Carp..... | 47,250,000 | 117,218,000 | Loch Leven trout.... | 85,000 | 94,220 |
| Shad..... | 65,667,000 | 37,549,000 | Lake trout..... | 53,753,000 | 44,247,500 |
| Glut herring..... | ..... | 55,130,000 | Brook trout..... | 19,947,900 | 16,110,810 |
| Alewife..... | 130,000 | ..... | Grayling..... | 700,000 | ..... |
| Whitefish..... | 422,769,000 | 540,776,000 | Smelt..... | ..... | 8,000,000 |
| Cisco..... | 181,150,000 | 317,200,000 | Pike perch..... | 416,100,000 | 508,942,000 |
| Chinook salmon..... | 51,793,000 | 43,829,820 | Yellow perch..... | 175,398,000 | 218,333,750 |
| Chum salmon..... | 15,417,000 | 28,182,000 | Striped bass..... | 19,358,000 | 24,600,000 |
| Humpback salmon.. | 579,300 | ..... | Cod..... | 912,417,000 | 482,012,000 |
| Silver salmon..... | 10,079,000 | 8,273,000 | Haddock..... | 406,235,000 | 635,950,000 |
| Sockeye salmon..... | 108,115,000 | 76,012,500 | Pollock..... | 954,800,000 | 650,850,000 |
| Steelhead salmon.. | 4,006,609 | 1,603,000 | Winter flounder..... | 1,805,167,000 | 1,980,291,000 |
| Atlantic salmon..... | 797,600 | 911,720 | Pole flounder..... | ..... | 19,410,000 |
| Landlocked salmon.. | 2,026,800 | 1,063,200 | | | |
| Rainbow trout..... | 9,631,200 | 10,994,750 | Total..... | 6,121,390,009 | 5,996,844,870 |

SUMMARY OF FISH-RESCUE WORK.

That part of the net output for the fiscal year 1921 derived from the rescue of stranded fishes is shown in the following table, which gives for each point from which the rescue work was conducted the total number of each species salvaged, the portion of that total restored to the original waters and the portion delivered to applicants: and for each species the total number rescued, the portion of that total restored to the original waters, and the portion delivered to applicants.

For a discussion of the rescue operations and suggestions for the enlargement of their scope, see page 78.

NUMBER AND DISPOSITION OF FISH RESCUED FROM OVERFLOWED LANDS, FISCAL YEAR 1921.

| Station. | Species. | Delivered to applicants. | Restored to original waters. | Total. |
|----------------------------------|----------------------------|--------------------------|------------------------------|------------|
| Bellevue, Iowa..... | Buffalofish..... | 150 | 313,865 | 314,015 |
| | Carp..... | 434 | 138,325 | 138,759 |
| | Catfish..... | 64,390 | 2,147,350 | 2,211,740 |
| | Crappie..... | 7,565 | 4,780,935 | 4,788,500 |
| | Drum..... | | 2,295 | 2,295 |
| | Largemouth black bass..... | 30,510 | 27,400 | 57,910 |
| | Pike and pickerel..... | 410 | 19,185 | 19,595 |
| | Pike perch..... | | 250 | 250 |
| | Sunfish..... | 35,120 | 3,595,630 | 3,630,750 |
| | White bass..... | 175 | 9,410 | 9,585 |
| | Yellow perch..... | 5,900 | 5,100 | 11,000 |
| | Miscellaneous..... | | 2,698,600 | 2,698,600 |
| Total..... | | 144,654 | 13,738,345 | 13,882,999 |
| Cairo, Ill..... | Buffalofish..... | | 107,350 | 107,350 |
| | Carp..... | | 44,715 | 44,715 |
| | Catfish..... | | 670,800 | 670,800 |
| | Crappie..... | | 170,800 | 170,800 |
| | Largemouth black bass..... | | 2,600 | 2,600 |
| | Pike and pickerel..... | | 4,900 | 4,900 |
| | Sunfish..... | | 55,250 | 55,250 |
| | White bass..... | | 800 | 800 |
| Total..... | | | 1,057,215 | 1,057,215 |
| Fairport (Iowa) and auxiliaries. | Buffalofish..... | | 104,473 | 104,473 |
| | Carp..... | | 53,757 | 53,757 |
| | Catfish..... | | 1,013,826 | 1,013,826 |
| | Crappie..... | 4,000 | 166,827 | 170,827 |
| | Drum..... | | 420 | 420 |
| | Largemouth black bass..... | 1,150 | 4,838 | 6,288 |
| | Pike and pickerel..... | 150 | 321 | 471 |
| | Sunfish..... | 8,300 | 71,711 | 80,011 |
| | White bass..... | | 3,176 | 3,176 |
| | Miscellaneous..... | | 5,872 | 5,872 |
| Total..... | | 13,900 | 1,425,221 | 1,439,121 |
| Homer, Minn..... | Buffalofish..... | | 30,165 | 30,165 |
| | Carp..... | 57 | 1,190,303 | 1,190,360 |
| | Catfish..... | 42,178 | 10,727,650 | 10,769,828 |
| | Crappie..... | 39,835 | 15,919,625 | 15,959,460 |
| | Drum..... | | 19,405 | 19,405 |
| | Largemouth black bass..... | 30,770 | 139,015 | 169,815 |
| | Pike and pickerel..... | | 175,040 | 175,040 |
| | Pike perch..... | | 108,265 | 108,265 |
| | Sunfish..... | 39,135 | 11,716,580 | 11,755,715 |
| | White bass..... | | 6,990 | 6,990 |
| | Yellow perch..... | 12,635 | 4,980,187 | 4,992,822 |
| | Miscellaneous..... | | 527,080 | 527,080 |
| Total..... | | 164,610 | 45,540,335 | 45,704,945 |

NUMBER AND DISPOSITION OF FISH RESCUED FROM OVERFLOWED LANDS, ETC.—Con.

| Station. | Species. | Delivered to applicants. | Restored to original waters. | Total. |
|----------------------------|----------------------------|--------------------------|------------------------------|-------------|
| La Crosse, Wis..... | Buffalofish..... | 1,020 | 799,510 | 800,530 |
| | Carp..... | 25 | 2,059,161 | 2,059,189 |
| | Catfish..... | 33,300 | 18,560,800 | 18,594,100 |
| | Crappie..... | 16,625 | 14,455,540 | 14,472,165 |
| | Drum..... | | 11,960 | 11,960 |
| | Largemouth black bass..... | 132,180 | 103,985 | 236,165 |
| | Pike and pickerel..... | | 322,130 | 322,130 |
| | Sunfish..... | 15,050 | 12,678,660 | 12,693,710 |
| | White bass..... | | 6,620 | 6,620 |
| | Yellow perch..... | 1,805 | 1,011,000 | 1,012,805 |
| | Miscellaneous..... | | 904,110 | 904,110 |
| | Total..... | 200,005 | 50,913,479 | 51,113,484 |
| Marquette, Iowa..... | Buffalofish..... | | 243,000 | 243,000 |
| | Carp..... | 85 | 340,515 | 340,600 |
| | Catfish..... | 19,650 | 1,098,350 | 1,118,000 |
| | Crappie..... | 5,650 | 1,620,250 | 1,625,900 |
| | Largemouth black bass..... | 33,940 | 5,990 | 39,930 |
| | Pike and pickerel..... | | 18,375 | 18,375 |
| | Rock bass..... | 75 | | 75 |
| | Sunfish..... | 11,800 | 1,627,100 | 1,638,900 |
| | Yellow perch..... | 5,800 | 211,625 | 217,425 |
| | Miscellaneous..... | | 788,500 | 788,500 |
| | Total..... | 77,000 | 5,953,705 | 6,030,705 |
| Quincy, Ill..... | Buffalofish..... | | 46,300 | 46,300 |
| | Carp..... | | 91,200 | 91,200 |
| | Catfish..... | 14,975 | 785,200 | 800,175 |
| | Crappie..... | 400 | 92,900 | 93,300 |
| | Largemouth black bass..... | 35,790 | 1,800 | 37,590 |
| | Sunfish..... | 5,740 | 139,560 | 145,300 |
| | Yellow perch..... | 150 | 50 | 200 |
| | Miscellaneous..... | | 11,000 | 11,000 |
| | Total..... | 57,055 | 1,168,010 | 1,225,065 |
| San Marcos, Tex..... | Catfish..... | | 70,000 | 70,000 |
| | Largemouth black bass..... | 2,886 | 60,000 | 62,886 |
| | Sunfish..... | | 70,000 | 70,000 |
| Total..... | | 2,886 | 200,000 | 202,886 |
| Total of all stations..... | Buffalofish..... | 1,170 | 1,644,663 | 1,645,833 |
| | Carp..... | 601 | 3,917,979 | 3,918,580 |
| | Catfish..... | 174,493 | 35,073,976 | 35,248,469 |
| | Crappie..... | 74,075 | 37,206,877 | 37,280,952 |
| | Drum..... | | 34,080 | 34,080 |
| | Largemouth black bass..... | 267,526 | 345,855 | 613,381 |
| | Pike and pickerel..... | 560 | 539,951 | 540,511 |
| | Pike perch..... | | 108,515 | 108,515 |
| | Rock bass..... | 75 | | 75 |
| | Sunfish..... | 115,145 | 29,954,491 | 30,069,636 |
| | White bass..... | 175 | 26,996 | 27,171 |
| | Yellow perch..... | 26,290 | 6,207,962 | 6,234,252 |
| | Miscellaneous..... | | 4,935,162 | 4,935,162 |
| | Grand total..... | 660,110 | 119,996,310 | 120,656,420 |

STATIONS AND SUBSTATIONS OPERATED AND OUTPUT OF EACH.

During the fiscal year 1921 fish-cultural work was conducted from 37 main stations, 32 substations, and approximately 60 egg-collecting or auxiliary stations. The following table gives the main fish-cultural stations, in alphabetical order, and the substations operative during the year, the period of operation of each, and the number of fish and eggs, by species, furnished for distribution by each station through propagation, through collections from auxiliary stations, and through rescue of fish from overflowed lands of the Mississippi Basin. It will be noted that transfers of fish and eggs from station to station are frequent. (For table of egg transfers, see p. 15.) Such transfers are made in the interest of economy and convenience

where the shipments consist of eggs and give advantageous distribution centers in the case of young fish.

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

| Station and period of operation. | Species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Total. |
|--|-------------------------|---------------|-------------|-------------------------------------|-------------|
| Afognak, Alaska: * Entire year..... | Sockeye salmon..... | (*) | 30,211,000 | 17,597,000 | 47,808,000 |
| Baird, Calif.: Entire year..... | Chinook salmon..... | | | 1,465,000 | 1,465,000 |
| Battle Creek, Calif.: * Entire year..... | do..... | (*) | | 1,781,000 | 1,781,000 |
| Mill Creek, Calif.: Entire year..... | do..... | 3,000,000 | | 1,347,400 | 4,347,400 |
| Baker Lake, Wash.: Entire year..... | Sockeye salmon..... | | 7,050,000 | | 7,050,000 |
| Birdsview, Wash.: * Entire year..... | Blackspotted trout..... | | 23,700 | | 23,700 |
| | Chinook salmon..... | | | 973,865 | 973,865 |
| | Chum salmon..... | | | 1,536,000 | 1,536,000 |
| | Silver salmon..... | | 600,000 | 2,176,000 | 2,776,000 |
| | Sockeye salmon..... | (*) | | 9,000 | 9,000 |
| | Steelhead salmon..... | * 85,000 | | 128,250 | 213,250 |
| Brinnon, Wash.: November-June..... | Chum salmon..... | | 1,500,000 | 575,000 | 2,075,000 |
| | Steelhead salmon..... | 100,000 | | | 100,000 |
| Duckabush, Wash.: Entire year..... | Chum salmon..... | | 5,500,000 | 5,682,000 | 11,182,000 |
| | Silver salmon..... | | | 50,000 | 50,000 |
| | Steelhead salmon..... | | | 1,095,000 | 1,095,000 |
| Quilcene, Wash.: Entire year..... | Chum salmon..... | | | 6,575,500 | 6,575,500 |
| | Silver salmon..... | | | 470,800 | 470,800 |
| | Steelhead salmon..... | 85,000 | | 303,500 | 388,500 |
| Quinault, Wash.: Entire year..... | Chinook salmon..... | | | 24,800 | 24,800 |
| | Silver salmon..... | | | 1,398,000 | 1,398,000 |
| | Sockeye salmon..... | | 950,000 | 3,448,000 | 4,398,000 |
| Sultan, Wash.: Entire year..... | Chinook salmon..... | | | 303,300 | 303,300 |
| | Silver salmon..... | | | 1,974,300 | 1,974,300 |
| | Steelhead salmon..... | | | 76,800 | 76,800 |
| Berkshire, Mass.: Entire year..... | Brook trout..... | | | 296,825 | 296,825 |
| | Rainbow trout..... | | | 41,900 | 41,900 |
| Boothbay Harbor, Me.: Entire year..... | Flounder..... | | 841,235,000 | | 841,235,000 |
| | Pollock..... | | 11,900,000 | | 11,900,000 |
| Bozeman, Mont.: * Entire year..... | Blackspotted trout..... | | 912,500 | 152,500 | 1,065,000 |
| | Brook trout..... | | | 546,950 | 546,950 |
| | Rainbow trout..... | * 325,000 | 1,250,000 | 798,000 | 1,373,000 |
| Glacier Park, Mont.: March-June..... | Blackspotted trout..... | | | 420,000 | 420,000 |
| | Brook trout..... | | | 30,000 | 30,000 |
| | Grayling..... | | 1,400,000 | | 1,400,000 |
| | Rainbow trout..... | | | 185,000 | 185,000 |
| Yellowstone, Wyo.: * July-September..... | Blackspotted trout..... | * 820,000 | 2,012,400 | | 2,832,400 |
| Cape Vincent, N. Y.: * Entire year..... | Brook trout..... | | 397,000 | | 397,000 |
| | Cisco..... | * 180,510,000 | 89,400,000 | | 275,910,000 |
| | Lake trout..... | 39,000 | 450,000 | | 489,000 |
| | Pike perch..... | | 7,970,000 | | 7,970,000 |
| | Rainbow trout..... | | 66,100 | | 66,100 |
| | Whitefish..... | * 89,650,000 | 40,300,000 | | 129,950,000 |
| | Yellow perch..... | | 11,000,000 | 2,150 | 11,002,150 |
| Central Station, Wash- ington, D. C.: Entire year..... | Brook trout..... | | | 36,200 | 36,200 |
| | Chinook salmon..... | | | 12,500 | 12,500 |
| | Cisco..... | | 400,000 | | 400,000 |
| | Pike perch..... | | 1,500,000 | | 1,500,000 |
| | Rainbow trout..... | | | 20,400 | 20,400 |
| | Shad..... | | 800,000 | | 800,000 |
| | Whitefish..... | | 800,000 | | 800,000 |
| | Yellow perch..... | | 500,000 | | 500,000 |
| Bryans Point, Md.: February-May..... | Shad..... | | 13,639,175 | | 13,639,175 |
| | Yellow perch..... | | 158,819,450 | | 158,819,450 |

¹ Fry produced at Meadow Creek auxiliary station.

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR
1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

| Station and period of operation. | Species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Total. |
|---|----------------------------|-----------|------------|-------------------------------------|------------|
| Clackamas, Oreg.: Entire year..... | Blackspotted trout..... | | | 95,000 | 95,000 |
| | Brook trout..... | | | 4,000 | 4,000 |
| | Chinook salmon..... | 130,000 | | 4,362,000 | 4,492,000 |
| Applegate, Oreg.— Entire year..... | do..... | | | 77,400 | 77,400 |
| | Silver salmon..... | | | 35,150 | 35,150 |
| | Steelhead salmon..... | | | 450,000 | 450,000 |
| Big White Salmon, Wash.— Entire year..... | Chinook salmon..... | | | 4,000,000 | 4,000,000 |
| Little White Salmon, Wash.— Entire year..... | do..... | 950,000 | | 12,190,000 | 13,140,000 |
| | Chum salmon..... | | | 5,067,900 | 5,067,900 |
| Rogue River, Oreg.— Entire year..... | Blackspotted trout..... | | | 47,500 | 47,500 |
| | Chinook salmon..... | | | 4,308,000 | 4,308,000 |
| | Rainbow trout..... | | | 189,500 | 189,500 |
| | Silver salmon..... | | | 381,900 | 381,900 |
| | Steelhead salmon..... | | | 866,000 | 866,000 |
| Salmon, Idaho— July-September..... | Chinook salmon..... | 2,700,000 | | | 2,700,000 |
| Upper Clackamas, Oreg.— Entire year..... | do..... | | | 1,935,500 | 1,935,500 |
| Washougal, Wash.— April-June..... | Steelhead salmon..... | 223,000 | 15,000 | | 238,000 |
| Willamette, Oreg.— July-June..... | Shad..... | | 2,347,100 | | 2,347,100 |
| Cold Springs, Ga.: Entire year..... | Catfish..... | | | 4,120 | 4,120 |
| | Crappie..... | | | 1,550 | 1,550 |
| | Largemouth black bass..... | | 144,750 | 67,805 | 212,555 |
| | Sunfish..... | | | 61,350 | 61,350 |
| | Warmouth bass..... | | | 100 | 100 |
| Craig Brook, Me.: Entire year..... | Atlantic salmon..... | | 1,387,000 | 280 | 1,387,280 |
| | Brook trout..... | | 1,085,000 | 23,625 | 1,108,625 |
| | Landlocked salmon..... | | 8,395 | 35,150 | 43,545 |
| | Sockeye salmon..... | | 17,500 | | 17,500 |
| Duluth, Minn.: * Entire year..... | Brook trout..... | | | 110,000 | 110,000 |
| | Lake trout..... | *100,000 | 6,057,000 | 147,500 | 6,304,500 |
| | Pike perch..... | | 8,500,000 | | 8,500,000 |
| | Rainbow trout..... | | | 20,500 | 20,500 |
| | Whitefish..... | | 9,600,000 | | 9,600,000 |
| Edenton, N. C.: Entire year..... | Glut herring..... | | 43,815,000 | | 43,815,000 |
| | Largemouth black bass..... | | | 23,085 | 23,085 |
| | Shad..... | | 16,006,000 | | 16,006,000 |
| | Sunfish..... | | | 9,905 | 9,905 |
| Weldon, N. C.— April-May..... | Striped bass..... | | 20,184,000 | | 20,184,000 |
| Erwin, Tenn.: Entire year..... | Brook trout..... | | | 300,435 | 300,435 |
| | Crappie..... | | | 400 | 400 |
| | Largemouth black bass..... | | 33,000 | 32,980 | 65,980 |
| | Rainbow trout..... | 55,000 | | 700,100 | 755,100 |
| | Rock bass..... | | | 17,200 | 17,200 |
| | Smallmouth black bass..... | | | 5,165 | 5,165 |
| | Sunfish..... | | | 20,350 | 20,350 |
| Fairport, Iowa, and sub- stations: Entire year..... | Buffalofish..... | | | 104,473 | 104,473 |
| | Carp..... | | | 53,757 | 53,757 |
| | Catfish..... | | | 1,013,826 | 1,013,826 |
| | Crappie..... | | | 170,827 | 170,827 |
| | Drum..... | | | 420 | 420 |
| | Largemouth black bass..... | | | 6,288 | 6,288 |
| | Pike and pickerel..... | | | 471 | 471 |
| | Sunfish..... | | | 80,011 | 80,011 |
| | White bass..... | | | 3,176 | 3,176 |
| | Miscellaneous..... | | | 5,872 | 5,872 |

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR
1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

| Station and period of operation. | Species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Total. |
|------------------------------------|----------------------------|----------------------------|---------------|-------------------------------------|---------------|
| Gloucester, Mass.: * | | | | | |
| Entire year..... | Cod..... | ² 208, 800, 000 | 50, 900, 000 | | 259, 700, 000 |
| | Flounder (pole)..... | 19, 410, 000 | | | 19, 410, 000 |
| | Flounder (winter)..... | | 132, 070, 000 | | 132, 070, 000 |
| | Haddock..... | 188, 940, 000 | 271, 880, 000 | | 460, 820, 000 |
| | Pollock..... | (*) | 443, 160, 000 | | 443, 160, 000 |
| Green Lake, Me.: | | | | | |
| Entire year..... | Brook trout..... | | 608, 050 | | 608, 050 |
| | Landlocked salmon..... | 495, 000 | 144, 720 | | 639, 720 |
| | Rainbow trout..... | | 26, 000 | | 26, 000 |
| | Smelt..... | 600, 000 | 7, 000, 000 | | 7, 600, 000 |
| Grand Lake Stream, Me.*— | | | | | |
| Entire year..... | Brook trout..... | | 47, 880 | | 47, 880 |
| | Landlocked salmon..... | *80, 000 | 55, 000 | 79, 100 | 214, 100 |
| Homer, Minn.: | | | | | |
| Entire year..... | Buffalofish..... | | | 30, 165 | 30, 165 |
| | Carp..... | | | 1, 190, 360 | 1, 190, 360 |
| | Catfish..... | | | 10, 769, 828 | 10, 769, 828 |
| | Crappie..... | | | 15, 959, 460 | 15, 959, 460 |
| | Drum..... | | | 19, 405 | 19, 405 |
| | Largemouth black bass..... | | | 169, 815 | 169, 815 |
| | Pike and pickerel..... | | | 175, 040 | 175, 040 |
| | Pike perch..... | | | 108, 265 | 108, 265 |
| | Rock bass..... | | | 3, 300 | 3, 300 |
| | Sunfish..... | | | 11, 755, 715 | 11, 755, 715 |
| | White bass..... | | | 6, 990 | 6, 990 |
| | Yellow perch..... | | | 4, 992, 822 | 4, 992, 822 |
| | Miscellaneous..... | | | 527, 080 | 527, 080 |
| Atchafalaya, La.— | | | | | |
| February–April..... | Buffalofish..... | | 40, 040, 000 | | 40, 040, 000 |
| Bellevue, Iowa— | | | | | |
| July–November..... | Buffalofish..... | | 68, 267, 000 | 314, 015 | 68, 581, 015 |
| | Carp..... | | 42, 718, 000 | 138, 759 | 42, 856, 759 |
| | Catfish..... | | | 2, 211, 740 | 2, 211, 740 |
| | Crappie..... | | | 4, 788, 500 | 4, 788, 500 |
| | Drum..... | | | 2, 295 | 2, 295 |
| | Largemouth black bass..... | | | 57, 910 | 57, 910 |
| | Pike and pickerel..... | | | 19, 595 | 19, 595 |
| | Pike perch..... | | | 250 | 250 |
| | Sunfish..... | | | 3, 630, 750 | 3, 630, 750 |
| | White bass..... | | | 9, 585 | 9, 585 |
| | Yellow perch..... | | | 11, 000 | 11, 000 |
| | Miscellaneous..... | | | 2, 698, 605 | 2, 698, 605 |
| La Crosse, Wis.— | | | | | |
| Entire year..... | Brook trout..... | | 107, 000 | 316, 050 | 423, 050 |
| | Buffalofish..... | | | 800, 530 | 800, 530 |
| | Carp..... | | | 2, 059, 189 | 2, 059, 189 |
| | Catfish..... | | | 18, 594, 100 | 18, 594, 100 |
| | Crappie..... | | | 14, 472, 165 | 14, 472, 165 |
| | Drum..... | | | 11, 960 | 11, 960 |
| | Largemouth black bass..... | | | 236, 165 | 236, 165 |
| | Pike and pickerel..... | | | 322, 130 | 322, 130 |
| | Rainbow trout..... | | 30, 000 | 53, 690 | 53, 690 |
| | Sunfish..... | | | 12, 693, 710 | 12, 693, 710 |
| | White bass..... | | | 6, 620 | 6, 620 |
| | Yellow perch..... | | | 1, 012, 805 | 1, 012, 805 |
| | Miscellaneous..... | | | 904, 110 | 904, 110 |
| Marquette, Iowa—July–November..... | | | | | |
| | Buffalofish..... | | | 243, 000 | 243, 000 |
| | Carp..... | | | 340, 600 | 340, 600 |
| | Catfish..... | | | 1, 118, 000 | 1, 118, 000 |
| | Crappie..... | | | 1, 625, 900 | 1, 625, 900 |
| | Largemouth black bass..... | | | 39, 930 | 39, 930 |
| | Pike and pickerel..... | | | 18, 375 | 18, 375 |
| | Rock bass..... | | | 75 | 75 |
| | Sunfish..... | | | 1, 638, 900 | 1, 638, 900 |
| | Yellow perch..... | | | 217, 425 | 217, 425 |
| | Miscellaneous..... | | | 788, 500 | 788, 500 |
| Meredosia, Ill.— | | | | | |
| July–November..... | Buffalofish..... | | | 46, 300 | 46, 300 |
| | Carp..... | | | 91, 200 | 91, 200 |
| | Catfish..... | | | 800, 175 | 800, 175 |
| | Crappie..... | | | 93, 300 | 93, 300 |
| | Largemouth black bass..... | | | 37, 590 | 37, 590 |
| | Sunfish..... | | | 145, 300 | 145, 300 |
| | Yellow perch..... | | | 209 | 209 |
| | Miscellaneous..... | | | 11, 000 | 11, 000 |

² Represents eggs fertilized and planted on spawning grounds.

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

| Station and period of operation. | Species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Total. |
|----------------------------------|----------------------------|---------------|---------------|-------------------------------------|---------------|
| Leadville, Colo.:* | | | | | |
| Entire year..... | Blackspotted trout..... | | 950, 500 | | 950, 500 |
| | Brook trout..... | *500, 000 | | 2, 706, 000 | 3, 206, 000 |
| | Lake trout..... | | | 24, 000 | 24, 000 |
| | Loch Leven trout..... | | | 34, 000 | 34, 000 |
| | Rainbow trout..... | | | 99, 500 | 99, 500 |
| Louisville, Ky.: | | | | | |
| Entire year..... | Largemouth black bass..... | | 32, 000 | 1, 100 | 33, 100 |
| | Rock bass..... | | | 4, 500 | 4, 500 |
| | Smallmouth black bass..... | | 146, 000 | 10, 700 | 156, 700 |
| | Sunfish..... | | | 76, 150 | 76, 150 |
| | Yellow perch..... | | 750, 000 | | 750, 000 |
| Cairo, Ill.— | | | | | |
| July-October..... | Buffalofish..... | | | 107, 350 | 107, 350 |
| | Carp..... | | | 44, 715 | 44, 715 |
| | Catfish..... | | | 670, 800 | 670, 800 |
| | Crappie..... | | | 170, 800 | 170, 800 |
| | Largemouth black bass..... | | | 2, 600 | 2, 600 |
| | Pike and pickerel..... | | | 4, 900 | 4, 900 |
| | Sunfish..... | | | 55, 250 | 55, 250 |
| | White bass..... | | | 800 | 800 |
| Mammoth Spring, Ark.: | | | | | |
| Entire year..... | Largemouth black bass..... | | | 1, 400 | 1, 400 |
| | Rock bass..... | | | 4, 725 | 4, 725 |
| | Smallmouth black bass..... | | 24, 000 | 2, 200 | 26, 200 |
| Manchester, Iowa:* | | | | | |
| Entire year..... | Brook trout..... | | | 466, 225 | 466, 225 |
| | Rainbow trout..... | *63, 500 | | 155, 950 | 221, 450 |
| | Rock bass..... | | | 53, 910 | 53, 910 |
| | Smallmouth black bass..... | | | 2, 500 | 2, 500 |
| Nashua, N. H.: | | | | | |
| Entire year..... | Brook trout..... | | | 735, 600 | 735, 600 |
| | Pike perch..... | | 1, 175, 000 | | 1, 175, 000 |
| | Rainbow trout..... | | | 42, 000 | 42, 000 |
| | Smallmouth black bass..... | | 31, 700 | | 31, 700 |
| Neosho, Mo.:* | | | | | |
| Entire year..... | Catfish..... | | | 3, 000 | 3, 000 |
| | Crappie..... | | | 13, 222 | 13, 222 |
| | Largemouth black bass..... | | | 20, 175 | 20, 175 |
| | Rainbow trout..... | *100, 000 | | 167, 965 | 267, 965 |
| | Rock bass..... | | | 10, 040 | 10, 040 |
| | Smallmouth black bass..... | | 1, 500 | 2, 701 | 4, 201 |
| | Sunfish..... | | | 31, 680 | 31, 680 |
| | Yellow perch..... | | | 58 | 58 |
| Northville, Mich.: | | | | | |
| Entire year..... | Brook trout..... | | 321, 000 | 148, 225 | 469, 225 |
| | Rainbow trout..... | | 42, 000 | 51, 575 | 93, 575 |
| | Smallmouth black bass..... | | | 31, 200 | 31, 200 |
| Bay City, Mich.— | | | | | |
| April-May..... | Pike perch..... | 277, 250, 000 | 7, 040, 000 | | 284, 290, 000 |
| Charlevoix, Mich.:* | | | | | |
| Entire year..... | Lake trout..... | *2, 685, 000 | 10, 000, 000 | | 12, 685, 000 |
| | Steelhead salmon..... | | 23, 810 | | 23, 810 |
| | Whitefish..... | 15, 000, 000 | 20, 000, 000 | | 35, 000, 000 |
| Orangeburg, S. C.: | | | | | |
| Entire year..... | Crappie..... | | | 300 | 300 |
| | Largemouth black bass..... | | | 204, 675 | 204, 675 |
| | Rock bass..... | | | 500 | 500 |
| | Sunfish..... | | | 14, 200 | 14, 200 |
| Put in Bay, Ohio:* | | | | | |
| Entire year..... | Carp..... | | 63, 325, 000 | | 63, 325, 000 |
| | Pike perch..... | | 12, 600, 000 | | 12, 600, 000 |
| | Whitefish..... | *77, 000, 000 | 167, 500, 000 | | 244, 500, 000 |
| St. Johnsbury, Vt.: | | | | | |
| Entire year..... | Brook trout..... | 256, 890 | 931, 900 | 85, 800 | 1, 274, 590 |
| | Lake trout..... | | 37, 000 | | 37, 000 |
| | Landlocked salmon..... | | | 10, 000 | 10, 000 |
| | Steelhead salmon..... | | | 5, 875 | 5, 875 |
| Holden, Vt.— | | | | | |
| Entire year..... | Brook trout..... | | 144, 500 | 29, 200 | 173, 700 |
| | Lake trout..... | | 19, 300 | 12, 350 | 31, 650 |
| | Rainbow trout..... | | | 400 | 400 |
| | Steelhead salmon..... | | | 3, 490 | 3, 490 |
| Swanton, Vt.:* | | | | | |
| March-May..... | Pike perch..... | *19, 225, 000 | 18, 100, 000 | | 37, 325, 000 |
| | Yellow perch..... | 12, 000, 000 | 5, 300, 000 | | 17, 300, 000 |

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p.15.]

| Station and period of operation. | Species. | Eggs. | Fry. | Fingerlings, yearlings, and adults. | Total. |
|----------------------------------|----------------------------|---------------|---------------|-------------------------------------|---------------|
| San Marcos, Tex.: | | | | | |
| Entire year..... | Black bass..... | | | 257,715 | 257,715 |
| | Catfish..... | | | 70,000 | 70,000 |
| | Crappie..... | | | 5,904 | 5,904 |
| | Rock bass..... | | | 320 | 320 |
| | Sunfish..... | | | 74,872 | 74,872 |
| Saratoga, Wyo.* | | | | | |
| Entire year..... | Blackspotted trout..... | | | 194,000 | 194,000 |
| | Brook trout..... | 100,000 | | 129,000 | 229,000 |
| | Rainbow trout..... | * 1,297,740 | | 145,000 | 1,442,740 |
| Spearfish, S. Dak.: | | | | | |
| Entire year..... | Brook trout..... | | | 530,000 | 530,000 |
| | Lake trout..... | | | 29,900 | 29,900 |
| | Loch Leven trout..... | | | 34,000 | 34,000 |
| | Rainbow trout..... | | | 126,945 | 126,945 |
| Springville, Utah:* | | | | | |
| Entire year..... | Blackspotted trout..... | | | 91,300 | 91,300 |
| | Brook trout..... | (*) | | 200,300 | 200,300 |
| | Catfish..... | | | 2,000 | 2,000 |
| | Rainbow trout..... | * 350,000 | | 172,000 | 522,000 |
| Paris, Idaho— | | | | | |
| March-April..... | Whitefish..... | | 600,000 | | 600,000 |
| Tupelo, Miss.: | | | | | |
| Entire year..... | Crappie..... | | | 1,280 | 1,280 |
| | Largemouth black bass..... | | 351,000 | 54,500 | 405,500 |
| | Sunfish..... | | | 73,005 | 73,005 |
| White Sulphur Springs, W. Va.: | | | | | |
| Entire year..... | Brook trout..... | | | 857,400 | 857,400 |
| | Crappie..... | | | 550 | 550 |
| | Largemouth black bass..... | | 25,800 | 600 | 26,400 |
| | Rainbow trout..... | * 250,000 | | 663,151 | 913,151 |
| | Rock bass..... | | | 175 | 175 |
| | Smallmouth black bass..... | | 100,500 | 125 | 100,625 |
| Woods Hole, Mass.: | | | | | |
| Entire year..... | Cod..... | (*) | 124,441,000 | | 124,441,000 |
| | Flounder..... | | 795,355,000 | | 795,355,000 |
| Wytheville, Va.: | | | | | |
| Entire year..... | Brook trout..... | | | 40,900 | 40,900 |
| | Crappie..... | | | 160 | 160 |
| | Largemouth black bass..... | | | 9,423 | 9,423 |
| | Pike perch..... | | 500,000 | | 500,000 |
| | Rainbow trout..... | * 110,000 | | 315,550 | 425,550 |
| | Rock bass..... | | | 14,060 | 14,060 |
| | Smallmouth black bass..... | | | 100 | 100 |
| | Sunfish..... | | | 10,325 | 10,325 |
| Yes Bay, Alaska: | | | | | |
| Entire year..... | Sockeye salmon..... | 350,000 | 550,000 | 9,380,500 | 10,280,500 |
| Gross output..... | | 1,109,637,130 | 3,626,264,230 | 226,682,195 | 1,962,583,555 |
| Loss in transit..... | | | 1,500 | 92,650 | 94,150 |
| Net output..... | | 1,109,637,130 | 3,626,262,730 | 226,589,545 | 4,962,489,405 |

EGG-COLLECTING OR AUXILIARY STATIONS.

The eggs hatched at the main stations and substations listed in the foregoing table are in many cases obtained from auxiliary sources, usually temporary stations occupied during the season only or, in some instances, mere camps, which are shifted from year to year. In the Great Lakes and off the New England coast collections are made by the bureau's vessels or boats in favorable localities. The following stations and egg-collecting points, operative for the periods indicated, furnished eggs of the given species for the main hatcheries during 1921.

EGG-COLLECTING STATIONS AND SPECIES HANDLED, FISCAL YEAR 1921.

| Stations. | Period of operation. | Species handled. |
|---|--|------------------------------|
| Bozeman, Mont.: | | |
| Meadow Creek, Mont..... | April to June..... | Rainbow trout. |
| Yellowstone Park, Wyo..... | July to September..... | Blackspotted trout. |
| Clear Creek..... | do..... | Do. |
| Columbine Creek..... | do..... | Do. |
| Cub Creek..... | do..... | Do. |
| Thumb Creek..... | do..... | Do. |
| Cape Vincent, N. Y.: | | |
| Bygotts Point, N. Y..... | November..... | Cisco, whitefish. |
| Chaumont Bay, N. Y..... | November and December..... | Do. |
| Deseronte, Canada..... | do..... | Do. |
| Fair Haven Bay, N. Y..... | do..... | Do. |
| Grass Bay, N. Y..... | May..... | Yellow perch. |
| Pigeon Island, Canada..... | October and November..... | Lake trout. |
| Sodus Bay, N. Y..... | November and December..... | Cisco. |
| South Bay, Canada..... | do..... | Whitefish. |
| Stony Island, N. Y..... | October and November..... | Lake trout. |
| Duluth, Minn.: | | |
| Boy River, Minn..... | April..... | Pike perch. |
| Briesburg, Minn..... | do..... | Do. |
| Grand Marais, Mich..... | October and November..... | Lake trout. |
| Keystone, Mich..... | do..... | Do. |
| Lac La Belle, Mich..... | do..... | Do. |
| Manitou Island, Mich..... | do..... | Do. |
| Marquette, Mich..... | do..... | Do. |
| Munising, Mich..... | do..... | Do. |
| Ontonagon, Mich..... | do..... | Do. |
| Portage, Mich..... | do..... | Do. |
| Washington Harbor, Mich..... | do..... | Do. |
| Green Lake, Me.: Fish River Lake, Me..... | November..... | Landlocked salmon. |
| Leadville, Colo.: | | |
| Carroll Lake, Colo..... | October and November..... | Brook trout. |
| Crystal Lake, Colo..... | do..... | Do. |
| Engelbrecht Lake, Colo..... | do..... | Do. |
| Evergreen Lake, Colo..... | do..... | Do. |
| Hen and Ford Lakes, Colo..... | do..... | Do. |
| Musgrove Lake, Colo..... | do..... | Do. |
| Northfield, Colo..... | do..... | Do. |
| Turquoise Lake, Colo..... | do..... | Brook and Loch Leven trouts. |
| Northville, Mich: | | |
| Alpena, Mich..... | November..... | Lake trout, white fish. |
| Cheboygan, Mich..... | do..... | Do. |
| Detour, Mich..... | do..... | Do. |
| Frankfort, Mich..... | do..... | Do. |
| Leland, Mich..... | do..... | Do. |
| Manistique, Mich..... | do..... | Do. |
| Northport, Mich..... | do..... | Do. |
| St. Ignace, Mich..... | do..... | Do. |
| St. James, Mich..... | do..... | Do. |
| St. Joseph, Mich..... | do..... | Do. |
| Scotts Point, Mich..... | do..... | Whitefish. |
| Put in Bay, Ohio: | | |
| Catawba Island, Ohio..... | November and December..... | Do. |
| Isle St. George, Ohio..... | do..... | Do. |
| Port Clinton, Ohio..... | November and December, April to June..... | Whitefish, carp, pike perch. |
| Toledo, Ohio..... | November and December, April..... | Whitefish, pike, perch. |
| St. Johnsbury, Vt.: | | |
| Darling Pond, Vt..... | September to December..... | Brook trout. |
| Lake Mitchell, Vt..... | September to November..... | Do. |
| Margalloway River, Me..... | do..... | Do. |
| Saratoga, Wyo.: | | |
| Canon Creek, Wyo..... | April to June..... | Rainbow trout. |
| Lost Creek, Wyo..... | do..... | Do. |
| Sage Creek, Wyo..... | do..... | Do. |
| Spearfish, S. Dak.: | | |
| Crow Creek, S. Dak..... | October to December..... | Brook and Loch Leven trouts. |
| Schmid Ponds, S. Dak..... | do..... | Do. |
| Springville, Utah: Fish Lake, Utah..... | October and November, April and May..... | Brook and rainbow trouts. |
| Woods Hole, Mass.: | | |
| Quissett, Mass..... | February and March..... | Winter flounder. |
| Waquoit, Mass..... | do..... | Do. |
| Wickford, R. I..... | March..... | Do. |

TRANSFERS OF EGGS.

For the convenient reference of persons interested in the results of the frequent interchange of fish eggs between the various stations of the bureau this table is prepared, indicating all such transfers of eggs during the fiscal year 1921. It is the intention to include a similar table in all future reports.

TRANSFERS OF EGGS, FISCAL YEAR 1921.

| Species. | Number of eggs. | From— | To— | Final disposition of fry or fingerlings. |
|----------------------------------|-----------------|-------------------------------|---------------------------------------|---|
| Blackspotted trout. ² | 50,000 | Yellowstone Park. | Birdsview, Wash.... | Washington waters. |
| | 25,000 | do..... | Clackamas, Oreg.... | Oregon waters. |
| | 1,000,000 | do..... | Leadville, Colo..... | Colorado waters. |
| | 200,000 | do..... | Saratoga, Wyo..... | Wyoming waters. |
| Brook trout ² ... | 800,000 | Leadville, Colo.... | Bozeman, Mont..... | Two Medicine Lake and Grinnel Creek, Glacier Park, and other Montana waters. |
| | 350,000 | Springville, Utah.... | do..... | do. |
| | 200,000 | do..... | Clackamas, Oreg.... | Oregon waters. |
| | 452,800 | do..... | Saratoga, Wyo..... | Wyoming waters. |
| | 200,000 | do..... | Spearfish, S. Dak.... | South Dakota waters. |
| Chinook salmon | 120,000 | Battle Creek, Calif. | Central station, Washington, D. C. | Pennsylvania waters. |
| Cisco..... | 1,000,000 | Cape Vincent, N. Y. | do..... | Cayuga Lake, N. Y. |
| Cod..... | 8,700,000 | Woods Hole, Mass. | Gloucester, Mass.... | Atlantic Ocean. |
| Lake trout..... | 25,000 | Charlevoix, Mich.... | Leadville, Colo..... | Twin Lakes, Colo. |
| | 25,000 | do..... | St. Johnsbury, Vt.... | Averill Lakes and Lowell Lake, Vt.; Silver Lake, Taylors Pond, and Winnesquam Lake, N. H. |
| | 25,000 | Duluth, Minn..... | Spearfish, S. Dak.... | Reclamation Reservoir, S. Dak.; Big Wind River, Wyo. |
| Landlocked salmon. ² | 10,000 | Grand Lake Stream, Me. | Craig Brook, Me.... | Pleasant Lake and Toddy Pond, Me. |
| | 25,000 | do..... | St. Johnsbury, Vt.... | Lake St. Catherine, Vt.; Lake George, N. Y. |
| Pike perch..... | 8,000,000 | Swanton, Vt..... | Cape Vincent, N. Y. | Lake Ontario, N. Y. |
| | 2,025,000 | do..... | Central station, Washington, D. C. | Perkiomen Creek, Lake Sheridan, Paupack River, and other Pennsylvania waters. |
| | 2,000,000 | do..... | Nashua, N. H..... | Merrimack River and tributaries, N. H. |
| | 500,000 | do..... | Wytheville, Va..... | New River, Va. |
| Pollock..... | 24,350,000 | Gloucester, Mass.... | Boothbay Harbor, Me. | Boothbay Harbor, Me. |
| Rainbow trout. | 250,000 | Bozeman: Meadow Creek, Mont. | Duluth, Minn..... | Clearwater River, tributary of, Minn. |
| | 225,000 | do..... | Manchester, Iowa.... | Reserved for brood stock. |
| | 250,000 | do..... | Spearfish, S. Dak.... | Spearfish Creek and tributaries, S. Dak. |
| | 260,000 | Manchester, Iowa.... | La Crosse, Wis..... | Spring Valley Creek and tributaries, and other Wisconsin waters. |
| | 298,991 | Neosho, Mo..... | Erwin, Tenn..... | Pigeon River and North Indian Creek, Tenn. |
| | 2105,000 | Saratoga: Sage Creek, Wyo. | Leadville, Colo..... | Platte River, Rifle Creek, and other Colorado waters. |
| | 2100,000 | Springville: Fish Lake, Utah. | Clackamas, Oreg.... | Alder Creek and Clackamas and Molalla Rivers, Oreg. |
| | 250,000 | do..... | Duluth, Minn..... | French and Sucker Rivers, Minn. |
| | 225,000 | do..... | Leadville, Colo..... | Platte River, Rifle Creek, and other Colorado waters. |
| | 2100,000 | do..... | Spearfish, S. Dak.... | Bear Butte, Horse, and Castle Creeks, S. Dak. |
| | 250,000 | White Sulphur Springs, W. Va. | Berkshire: Harts-ville, Mass. | Housatonic and Westfield Rivers, Mass. |
| | 225,000 | do..... | Central station, Washington, D. C. | Potomac and Beaverdam Rivers, Md. |
| | 257,000 | do..... | Northville, Mich.... | Au Sable and Pere Marquette Rivers, Mich. |
| | 250,000 | do..... | St. Johnsbury, Vt.... | Crescent Pond, N. Y. |
| | 2150,000 | Wytheville, Va.... | Cape Vincent, N. Y. | Horseshoe Pond, Salmon Creek, and Neversink River, N. Y. |
| | 220,000 | do..... | Central station, Washington, D. C. | Potomac and Beaverdam Rivers, Md. |
| | 250,000 | do..... | Green Lake, Me..... | Great Brook and Beaver Pond, Me. |
| | 250,000 | do..... | Nashua, N. H..... | Cold and Nashua Rivers, N. H. |
| | 2100,000 | do..... | White Sulphur Springs, W. Va. | Cheat and Cranberry Rivers and tributaries and other West Virginia waters. |

TRANSFERS OF EGGS, FISCAL YEAR 1921—Continued.

| Species. | Number of eggs. | From— | To— | Final disposition of fry or fingerlings. |
|--------------------------------|-----------------|----------------------|-----------------------------------|---|
| Sockeye salmon ¹ | 3,000,000 | Afognak, Alaska. | Quinalt, Wash.... | Quinalt Lake, Wash. |
| | 5,000,000 |do..... | Yes Bay, Alaska.... | McDonald Lake, Alaska. |
| | 30,000 | Birdsview, Wash.... | Clackamas, Oreg.... | Columbia River, Oreg. |
| | 420,000 |do..... | Craig Brook, Me.... | Pleasant River, Me. |
| Steelhead salmon. ² | 25,000 |do..... | Charlevoix, Mich.... | Hortons Creek, Mich. |
| | 10,000 |do..... | Erwin, Tenn..... | Reserved for brood stock. |
| | 25,500 |do..... | Manchester, Iowa.... | Do. |
| | 58,000 |do..... | St. Johnsbury, Vt.... | Lake Tarleton, N. H.; Cayuga Lake, N. Y.; and Peacham Pond, Vt. |
| | | | | Cayuga Lake, N. Y |
| Whitefish..... | 750,000 | Cape Vincent, N. Y. | Central station, Washington, D.C. | Do. |
| | 750,000 | Put in Bay, Ohio.... |do..... | Do. |
| | 59,120,000 |do..... | Charlevoix, Mich.... | Lake Michigan. |
| | 10,000,000 |do..... | Duluth, Minn..... | Lake Superior. |

¹ For exhibit—fingerlings delivered to Pennsylvania Fish and Game Commission.

² Eggs from wild stock.

³ Eggs from domesticated stock.

⁴ This transfer was due to a misunderstanding of orders.

Propagation of Commercial Fishes.

The more important commercial fishes propagated by the bureau are the salmons of the Pacific coast, the whitefish, cisco (lake herring), lake trout, pike perch, and yellow perch of the Great Lakes, the yellow perch of the Potomac, the carp in the Portage River section of Ohio, the marine species—including the cod, haddock, pollock, winter and pole flounders—the buffalofish in Louisiana, and the anadromous fishes of the Atlantic coast—the shad, glut herring, alewife, striped bass, and Atlantic salmon. A discussion of the propagation of these fishes at the various stations during the fiscal year 1921 follows. Data concerning the spawning seasons for the species at the different stations are assembled in the table on page 72, and the amount and cost of fish food used at the Pacific salmon stations are given in the table on page 75.

PACIFIC SALMON CULTURE.

With the recent increase in the cost of all labor and materials the bureau has found it impossible to maintain the former magnitude of its Pacific salmon operations or to keep pace with the work done along that line by the various State commissions. The Yes Bay (Alaska) station was temporarily closed in order that its allotment of funds might be used to rebuild the water-supply line and make repairs to the hatchery and its equipment, such action being essential to prevent complete deterioration of valuable Government property. In the following pages is given a brief review of the work of the hatcheries on the Pacific coast.

AFOGNAK (ALASKA) STATION.

[EDWIN WENTWORTH, Superintendent.]

There was another excellent run of sockeye salmon in Letnik Lake, and during the active spawning season, extending from July 31 to September 24, 62,300,000 eggs were laid down in the hatchery. This

is the fourth consecutive year that the egg collections have exceeded 50,000,000, and it would seem to indicate the permanency of the reestablished run, which was practically destroyed by the volcanic eruption of 1912. In none of these years do the egg collections afford an accurate index to the numbers of fish entering the lake, as it is the exceptional season when conditions are such as to permit active fishing throughout the spawning season. Thus, many of the fish annually escape to perform the spawning function under natural conditions. During the fiscal year 1920 upward of 79,000,000 eggs were taken, after which the racks were removed from the spawning streams. It was estimated that not more than 50 per cent of the spawning salmon entering the lake were used. During the season of 1921 the egg collections did not fill the hatchery, as floods during August prevented successful fishing.

Of the eggs collected 10,000,000 were transferred to other points, 5,000,000 going to the Yes Bay (Alaska) station, 2,000,000 to Quinault, Wash., and 3,000,000 to the State fish hatchery at Bonneville, Oreg., in continuance of an effort to restock the Columbia River with the species. The eggs retained at the station were incubated with a loss of $6\frac{1}{2}$ per cent. In view of the excellent run of sockeye salmon that has entered Letnik River during the past four years, it may not be amiss to consider the opening of Letnik Bay to commercial fishing for the species after it has been ascertained that a sufficient number of fish has entered the lake to insure a satisfactory number of eggs for artificial incubation. This would involve the installation of a rack, making it possible to count the salmon passing through. It is believed the same rack would be useful in excluding Dolly Varden trout and silver salmon from the lake should this be considered advisable. The water temperature at the beginning of the spawning period registered 52° F.; at its close, 40° .

YES BAY (ALASKA) STATION.

[C. H. VAN ATTA, Superintendent.]

Fish-cultural work at this station was confined to the incubation of the sockeye-salmon eggs transferred from the Afognak station, 4,025,000 fingerlings resulting from the 5,000,000 eggs received. During December 350,000 of the eyed eggs were planted in three local lakes, which have been designated as Cannery Lake, Round Lake, and Lake No. 2. These bodies of water do not at present support a run of salmon, though they appear to be suited to the purpose. A rather casual inspection of the lakes on May 17 disclosed several schools of sockeye-salmon fingerlings from 1 to $1\frac{1}{2}$ inches long. Each school was estimated to contain from 25 to 75 fish.

In view of the extensive repair work in hand it was not possible to take up fish-cultural operations on the usual scale. The repairs were essential to prevent complete deterioration of valuable property and were made from the funds usually allotted for propagation, the special appropriation requested by Congress for the purpose having been refused. The main features of the work consisted in the installation of a new water supply and extensive repairs to the hatchery building, including new foundation piling, new floors, and a complete set of 240 hatching troughs. The water supply required

approximately 4,000 feet of 18-inch and 16-inch wood stave pipe, which was carried on a trestle from 1 foot to 24 feet high, and 1,250 feet of 6-inch pipe to provide water for domestic use and for fire protection. The trestle is made to accommodate a tramcar and makes available for station use an excellent supply of firewood and lumber, also, after the station has been equipped with a sawmill. The work also included repairs to other station buildings and the construction of a new launch. The station is now on an operating basis again, and fish-cultural work will be resumed during 1922.

During the fiscal year 1920 a system of feeding young salmon that had been in successful operation in the Washington field for some time was tried at the Yes Bay station. An arm of McDonald Lake, locally known as McDonald Slough, was temporarily screened, and a considerable number of young sockeye salmon were placed therein. The fish were fed regularly on salted salmon and made a very excellent growth. The results of the experiment were so satisfactory that piling has been driven to make the feeding inclosure a permanent feature of the station's work.

BAKER LAKE (WASH.) STATION AND SUBSTATIONS.

[J. R. RUSSELL, Superintendent.]

Necessity for economy has compelled the suspension of fish-cultural operations at three of the field stations in the Washington group in the past two years, and this has tended to reduce the output in that region. The combined output of the Washington stations for the fiscal year 1921, exclusive of Quinault, is 36,873,015, against 33,086,750 for the preceding year, 20,393,315 of the 1921 figures representing fingerlings, as opposed to a production of 9,842,350 fingerlings in 1921.

BAKER LAKE (WASH.) STATION.

Of particular interest in connection with the fish-cultural work in this field was the excellent run of sockeye salmon at Baker Lake. The run began on July 1, when 115 adult fish were taken, and continued to August 13, the peak of the run occurring between July 20 and 24. A total of 7,850 spawning fish were taken. The spawning period extended from October 10 to November 30. About 46 per cent of the total brood stock, or 3,645 fish, proved to be gravid females and yielded 11,750,000 eggs. This is the largest collection of sockeye-salmon eggs obtained at Baker Lake, exceeding last year's record collection by 600,000. The incubation period was unusually protracted, the first fry appearing on April 1, nearly three months later than in the preceding year, and hatching operations were not completed until May 31. The long incubation season was attributable to low water temperatures, brought about by cold spring weather and late snowstorms in the mountains. Apparently there were no ill effects to either eggs or fry, as the loss of eggs amounted to only 3.6 per cent, while the fry hatched seemed to possess the usual vigor.

Though it has not been possible to replace all equipment destroyed by the fire of last year, all of the fry produced were retained in the hatchery troughs to the end of the sac stage, this being effected through the use of the stacked-tray system. There remained on hand

at the close of the fiscal year 4,000,000 of these young salmon, which will be reared to a larger size before liberating. In connection with its rearing operations the bureau is indebted to the fish and game authorities of the State of Washington, which furnished without charge 1,000 cases of canned salmon "do-overs" to be utilized as food for the fish.

The improved run of sockeye salmon in Baker Lake seems especially noteworthy from the fact that for more than 20 years the maintenance of the run of this species has depended almost exclusively on artificial propagation. It has been the custom at this point to trap all fish as they enter Baker Lake from the river and transfer them to an inclosure near the head of the lake, where they are held until ready to spawn. Thus, only the comparatively few fish which occasionally escape the trap during high-water periods spawn naturally in the lake.

In addition to the sockeye-salmon operations 700,000 silver-salmon eggs were taken between November 17 and December 15. In pursuance of the adopted policy of reserving Baker Lake so far as possible for the propagation of sockeye salmon, these eggs were transferred to the Birdsvew hatchery immediately after being eyed.

BIRDSVIEW (WASH.) SUBSTATION.

The work of the Birdsvew substation, on the Skagit River, was also successful. Its output of chinook salmon was larger than in any previous year, and the collections of silver and steelhead salmon eggs were above the average. This substation is now dependent on the fish that enter Grandy Creek for its egg collections. The trap in Phinney Creek, formerly a valuable egg-producing stream, was destroyed by floods two years ago, and since that time funds for its replacement have not been available. The success of the work at this point is attributed largely to the favorable water stages which prevailed throughout the spawning season. The streams in this locality are subject to sudden and violent fluctuation, and not infrequently at the spawning season the water is at such a low stage as to make the ascent of fish difficult, if not impossible. Of passing interest is the collection of 13,500 sockeye-salmon eggs from fish taken in Grandy Creek, the result, apparently, of plants of that species made by the bureau in Grandy Lake.

BRINNON, DUCKABUSH, AND QUILCENE (WASH.) SUBSTATIONS.

The propagation of chum salmon at the three substations on Hood Canal—Brinnon, Duckabush, and Quilcene—was unusually successful from the standpoint of egg collections and numbers of fry produced. Thirteen million eggs of this species, taken in Walcotts Slough, at the Brinnon substation, represented the largest number of eggs taken in that region. The egg collections do not accurately represent the numbers of spawning fish in the streams, since many escaped during the high-water stages, which were frequent during the spawning period and adversely affected the work at all points on the canal.

There are two distinct runs of chum salmon in the tributaries of Hood Canal. The spawning of the first, or summer run, occurs

in September, while the late or winter run spawns from early November to well into January. A peculiarity of this species is that the fish in most instances are in spawning condition when they leave salt water to enter the streams, and most of the eggs collected in the Washington field are obtained in tidewaters. The increased collections of chum-salmon eggs within the past two years may be attributed to the lessened activity of commercial fishermen, the low prices prevailing offering but little inducement to fish.

There was a satisfactory run of silver salmon at the Hood Canal substations, though egg collections fell below those of the preceding year because the run occurred at a time when floods prevented the successful operation of traps or seines, a condition that continued to prevail throughout the spring spawning season of the steelhead salmon.

QUINULT (WASH.) SUBSTATION.

[PHILO B. HAWLEY, Foreman in Charge.]

The fish-cultural work at this substation during the year was less successful than usual, the aggregate output amounting to only 5,820,800 as compared with 15,908,600 in 1920. Eggs at this point are obtained from fish taken in traps or by other means in the tributaries of Quinault Lake, which, like most streams in a mountainous country, react quickly to climatic conditions, a heavy rain producing flood conditions almost immediately. The waters rapidly subside on the cessation of rain, while even a short period of dry weather causes low water stages at all points. Fishing operations are conducted in the streams at some distance from the hatchery, the eggs being transported by canoe. Every season there are times when the water stages in the upper Quinault and Big Creek, the principal spawning streams, are so low that it is difficult to operate a canoe, while at other times the water is so high that all traps are submerged to a depth of 1 to 5 feet.

As it is characteristic of salmon to ascend the streams in the greatest numbers during high-water stages, it is not surprising that the egg collections should be subject to material fluctuation from year to year. Thus, the number of eggs of any species taken is not necessarily a just criterion of the number of salmon available at spawning time. The remedy for this situation, from a fish-cultural standpoint, is the construction of a trap at the lake outlet similar to the one used at the Baker Lake station, whereby all the fish are taken as they enter and are held in an inclosure until they are ready to spawn.

The first sockeye-salmon eggs were taken November 3, and between that date and November 20 the entire egg collections for the season, amounting to 1,750,000, were obtained. From November 20 to the time that efforts at spawn taking were abandoned, on December 15, high-water stages precluded all possibility of seining or fishing by other methods. Local collections of this species were augmented by the receipt of 2,000,000 eggs from the Afognak station. The run of silver salmon appeared to be larger than usual, and during the spawning season of that species, which is coincident with that of the sockeye, 1,565,000 eggs were secured. A small number of chinook-salmon eggs was also taken. The run of chinooks, which was apparently not large, was earlier than usual.

The output consisted of 950,000 fry and 3,448,000 fingerlings of the sockeye salmon, including 1,500,000 fingerlings carried over from the preceding year, 1,398,000 silver salmon, and 24,800 chinook fingerlings, with 1,000,000 sockeyes remaining on hand at the close of the fiscal year.

From time to time there has been some criticism regarding the bureau's work at Quinault, particularly on the part of the Quinault Indians. The substation is located on the Quinault Indian Reservation, and salmon fishing is the principal means of support for the Indians. Following the passage of regulations that had the effect of restricting salmon fishing to some extent in the Quinault River, a petition was submitted to the Commissioner of Indian Affairs, expressing the belief of the petitioners that the work of the hatchery had been detrimental rather than beneficial to the fishery of the river. The statement appeared to be founded on prejudice rather than on fact. The results of artificial propagation at other points do not bear out the contention, and in Quinault waters the fish taken for artificial propagation represent but a small part of the fish reaching the spawning grounds, probably not more than 10 per cent in any season. Furthermore, for several years considerable numbers of sockeye-salmon eggs transferred from the Alaska stations have been incubated in the Quinault hatchery and the resulting fingerlings planted in Quinault Lake or its tributaries.

Notwithstanding these facts, it was decided to try an experiment, which it was hoped would furnish reasonably reliable data on the results of artificial propagation as compared with natural reproduction. The plan suggesting itself was to take an accurate census of the sockeye salmon entering Quinault River and Quinault Lake for a period of years and by checking the returns from each year involved to secure at the proper time the desired figures for comparison. During the first two years of this period no artificial propagation of the sockeye salmon was to be conducted, and all fish of that species entering the lake were to be permitted to seek their natural spawning grounds for natural reproduction, this period to be followed by two years of artificial propagation.

Conditions in Quinault Lake and Quinault River are particularly favorable for the conduct of an experiment of this character. A fairly accurate record of the number of fish taken by the Indians as a commercial venture each season is available, and it remained only to obtain a count of the fish escaping the fishing operations in the river as they entered the lake on their way to the spawning grounds. To accomplish this a row of piling was driven across the outlet of the lake, approximately 700 feet at the site selected. Four-inch mesh cotton webbing was attached to the piling in such a manner as to prevent the fish from entering the lake except by way of a 16-foot entrance provided in the weir at the point of deepest water. This entrance was so arranged that the fish were forced to pass near the surface of the water over a strip of white canvas, making them plainly visible to the attendant located in a small building on the piling above. Provision was also made for closing the entrance at times when the observer was not present. The first count was made on April 14, when three sockeyes passed over the counting entrance, and was continued to June 10. The results of the census are indicated in the following table:

| Date. ¹ | Number of fish. | Date. ¹ | Number of fish. |
|--------------------|--------------------|--------------------|--------------------|
| April 14..... | 3 | May 16..... | 118 |
| 15..... | 1 | 17..... | 405 |
| 16..... | 16 | 18..... | 30 |
| 17..... | 1 | 19..... | 19 |
| 18..... | 3 | 20..... | 255 |
| 19..... | 3 | 21..... | 11 |
| 20..... | 23 | 22..... | 788 |
| 21..... | 0 | 23..... | 103 |
| 22..... | 9 | 24..... | 65 |
| 23..... | 2 | 25..... | 171 |
| 24..... | 23 | 26..... | 129 |
| 26..... | 3 | 27..... | 228 |
| 27..... | 2 | 28..... | 962 |
| 28..... | 1 | 29..... | 299 |
| 29..... | 44 | 30..... | 606 |
| May 1..... | 4 | 31..... | 610 |
| 2..... | 51 | June 1..... | 649 |
| 5..... | 96 | 2..... | 1,685 |
| 6..... | 1 | 3..... | 563 |
| 7..... | 20 | 4..... | 208 |
| 8..... | 151 | 5..... | 13 |
| 9..... | 18 | 6..... | 853 |
| 10..... | 11 | 7..... | 186 |
| 11..... | 246 | 8..... | 826 |
| 12..... | 421 | 9..... | 164 |
| 13..... | 230 | 10..... | 90 |
| 14..... | 82 | | |
| 15..... | 286 | Total..... | 11,788 |

¹ No count made on dates omitted.

The count was discontinued and the webbing removed from the piling on June 10 because of the increasing numbers of fish that "gilled" in the 4-inch mesh. This trouble was not anticipated, as the webbing was of the same quality and mesh as that used at the Baker Lake station for a long period of years with entire success, and the 4-inch mesh is in general use for fish traps on Puget Sound. An estimate of the fish entering the lake after the removal of the webbing placed the number at 8,000, or a total of approximately 20,000 for the season. Inasmuch as it was not possible to obtain a complete and accurate record, it was decided to postpone the experiment for another season and proceed with artificial propagation as usual. With slight changes the weir constructed for the purpose described will be of value in connection with fish-cultural work should it be found desirable to continue such work after the conclusion of the experiment. The number of sockeye salmon taken in the commercial fisheries conducted by the Indians in Quinault River during this period amounted to 28,608.

SULTAN (WASH.) SUBSTATION.

At the Sultan substation, on Elwell Creek, there was a falling off in the egg collections of all species as compared with those of the preceding year. This creek is a tributary of the Skykomish River, which joins the Snohomish River at tidewater, some 20 miles from its mouth. This 20-mile stretch of the Snohomish River is subjected to intensive gill-net fishing operations each year, and it is extremely doubtful if the fish which are able to escape the nets during the fishing season, together with those that are given free ascent of the stream during the closed season, are sufficient in number to maintain the run in the watershed.

CLACKAMAS (OREG.) STATION AND SUBSTATIONS.

[H. C. MITCHELL, Superintendent.]

Under this heading are included the four Federal fish-cultural stations in the State of Oregon, two located on the Washington side of the Columbia River, with one egg-collecting station on the Washougal River, also in the State of Washington, and another on the Snake River, near Salmon, Idaho. The aggregate egg collections during the fiscal year 1921 were 42,912,320, and though the chinook salmon predominates in the work all species of the Pacific salmon excepting the sockeye and including the steelhead are represented. The shad is also propagated at Willamette Falls, Oreg., and the output is further augmented by the incubation of eggs of other species obtained by transfer from various points, and the distribution of the resulting fish in Oregon, Washington, and Idaho waters. The species thus transferred consist of brook trout, rainbow trout, blackspotted trout, and sockeye salmon.

In line with the very general belief, which appears to be well substantiated by reliable investigators, that much greater returns may be expected from the planting of larger-sized fingerling fish, particularly in the case of the chinook salmon, it has been the policy to develop facilities as rapidly as possible for this purpose. The stations in the Oregon field have an excellent record in this respect. During the fiscal years 1919-20 and 1920-21, an aggregate of approximately 83,500,000 fish from 2 to 3½ inches long have been planted in suitable waters of the State. These consist largely of the chinook salmon, though, as mentioned before, smaller numbers of brook, rainbow, and blackspotted trouts and steelhead salmon are included.

In contrast with the conditions that obtained during the previous spawning season of the salmon, when low-water stages at all points handicapped the work, floods prevailed in most of the streams during the season covered by this report. While it was not possible to state with accuracy to what extent the operations were curtailed by the floods, there is reason to believe that with more nearly normal weather conditions the aggregate collection of eggs would have exceeded that of any preceding year and that at some points the eggs available would have been in excess of hatchery capacity.

CLACKAMAS (OREG.) STATION.

Though the racks installed in the Clackamas River in connection with operations at Clackamas station were of unusually substantial construction and remained intact through two severe freshets they were carried away on October 3, and the egg-collecting season ended on that date. Though a very fair number of chinook and silver salmon had collected between the racks prior to their destruction, conditions in the river were such as to render the laying out and operation of a seine impossible. Consequently, the egg collections were reduced very considerably, totaling only 360,000 of the chinook salmon. Shad culture at Willamette Falls during July resulted in the collection of 2,119,000 eggs of that species. Transfers of eggs from other points were made as follows: 3,166,000 chinook salmon from Snake River (Idaho) station, 100,000 chinook salmon

from Little White Salmon (Wash.) station, 100,000 blackspotted trout from Montana Fish and Game Commission, 25,000 blackspotted trout from Yellowstone Park, and 197,000 brook trout and 96,000 rainbow trout from Springville (Utah) station.

UPPER CLACKAMAS (OREG.) SUBSTATION.

The spring run of chinook salmon in the Clackamas River was the largest for a number of years, and egg collections of that species at the Upper Clackamas substation exceeded the previous season's record collection by nearly 800,000. Racks were installed early in July and fishing operations continued until September 16, when high water permitted the escape of all remaining fish, probably two-thirds of all the fish intercepted by the racks getting away at this time. There has been a most decided improvement in the annual run of spring chinooks in this stream, and the station, though small, is of importance to the fisheries of the Clackamas River. Because of its exceptionally attractive and convenient location and its well-kept condition it is a point much favored by visitors. Unfortunately, the Clackamas River is difficult to protect against the poacher, and illegal fishing is prevalent.

LITTLE WHITE SALMON AND BIG WHITE SALMON (WASH.) SUBSTATIONS.

There was a lighter fall run of chinook salmon in the Columbia River in the fall of 1920 than has occurred for several previous years. To offset this there were not the intensive fishing operations witnessed throughout the period of the war, and the demand for chum and silver salmon was particularly light. As at all points in the Oregon field, the persistent high-water stages throughout the spawning period rendered the work of the spawn-taking crews difficult and hazardous, and at times the streams were quite beyond control. The run of chum salmon was of fair proportions, but it occurred at a time when it was possible to obtain only a limited number of eggs, and only a small proportion of the fish were obtained for propagation. During the run of silver salmon the floods were so severe as to make fishing impossible; therefore no eggs of this species were recorded.

The collections of fish eggs at the Little White Salmon substation for the year consisted of 16,950,000 chinook salmon (of which 2,000,000 were sent to the Big White Salmon substation and 1,100,000 to the Clackamas station) and 5,162,000 chum-salmon eggs. This substation also handled 30,000 sockeye-salmon eggs transferred from the Washington field. At the Big White Salmon substation 5,005,000 chinook-salmon eggs represent the total egg collections.

ROGUE RIVER (OREG.) SUBSTATION.

Operations at the Rogue River substation suffered less from the prevalent floods than at any other point in the field, and 4,438,000 chinook salmon, 506,000 silver salmon, and 121,500 steelhead salmon eggs were secured. There were on hand at the beginning of the year 49,500 blackspotted trout, 886,000 steelhead salmon, and 197,000 rainbow trout fry, all of which entered into the distribution from the station later in the year.

APPLEGATE (OREG.) SUBSTATION.

At the other substation in southern Oregon, on Applegate Creek, the rainfall was excessive, and while higher water stages are frequently witnessed in the stream than occurred at any time during the season of 1921 still the amount of water carried during the year was unusually large. Placer mining at points on the creek above the station has resulted in large deposits of gravel at the fish barrier which will necessitate some changes before the next spawning season. Egg collections were unusually light, as most of the spawning fish escaped over the racks. The results of the season's egg collections were 80,000 chinook salmon, 36,000 silver salmon, and 55,000 steelhead salmon.

WASHOUGAL RIVER (WASH.) SUBSTATION.

The substation on Washougal River was opened on April 15, and 359,000 eggs of the steelhead salmon were obtained. High water and the lumber work on the river were both sources of trouble and interfered with the egg-collecting work. From the collections shipments of eyed eggs were made to the New York Conservation Commission, to the Clarke County Game Commission at Vancouver, Wash., and to the Montana Fish and Game Commission in exchange for blackspotted trout eggs.

Some unusual features have been observed in connection with the work at this point. Last season it was noted that the fish remained quietly in the pools below the dam, showing but little inclination to ascend the river. Furthermore, the eggs secured were of poor quality, only 29 per cent of them producing fry. It is doubted if eggs of first quality were obtained from any of the female fish handled. The cause of this unsatisfactory condition was not ascertained, but the theory was advanced that the newly erected dam which stops the fish many miles below their wonted spawning grounds was responsible. In view of the excellent quality of the steelhead eggs taken at other points under very similar conditions, this theory is not altogether tenable. During the season of 1921 the quality of the eggs obtained was much better, though a considerable number of fish were taken in which small undeveloped eggs were distinguishable. There was nothing in the appearance of the fish to lead one to suppose they would spawn during that season. It is a condition not previously observed at any point, and it is more or less perplexing. It may be analogous to recorded instances of Atlantic salmon seeking their spawning grounds in fresh-water streams a full year in advance of the time they were ready to perform the spawning function and remaining there until that purpose was accomplished.

SALMON (IDAHO) SUBSTATION.

The results of the season's work on the Snake River were very satisfactory. The racks were installed in Lemhi Creek before the end of the fiscal year 1920, and a good run of fish appeared early in July. Spawning began on August 14, and between that date and September 1, 6,000,000 eggs were secured, filling all available space in the eying station troughs. Immediately after this the racks were removed, and the fish remaining in the stream were permitted

to ascend to their natural spawning grounds. It is probable that the numbers of fish thus released for natural spawning exceeded those involved in the egg collections. This substation is located within 10 miles of the "top" of the Rocky Mountains, in the State of Idaho, and to reach this mountain stream for the accomplishment of their supreme mission in life the salmon travel approximately 1,500 miles without food after entering the Columbia River at Astoria, Oreg. The conditions which were observed here in regard to the splendid spring run of chinook salmon were not confined to the Snake River. Similar conditions were observed in all tributaries of the Columbia River frequented by the so-called spring-run fish.

Very excellent results in the rearing of young salmon have been obtained from the use of a comparatively new article of fish food. This is the immature spawn of the salmon taken by the commercial fishermen. The spawn is purchased at a comparatively low cost and held in cold storage until needed. In commenting on its value in his annual report for 1920 the superintendent of the station states:

The salmon fry fed on salmon spawn and beef spleen produced remarkably fine fingerlings. It is by far the most satisfactory food that has ever been used in this field. No trouble was experienced with the fish at any point where its use was adopted. They were uniformly sturdy and readily accepted it throughout the year.

While the expense involved in feeding fish on an extensive scale is considerable, in view of the quite general belief that the future supply of salmon in the Columbia and other rivers of the State is dependent very largely on the numbers of fingerling fish released from the hatcheries, the work is considered of first importance. Because of the long period during which so little is known of the life of the salmon—from the time of the seaward migration as a fingerling or yearling until its return for the reproduction of its kind—it is difficult to effect any positive check on the actual results of hatchery work. Nevertheless, the evidence in favor of the work at certain points, notably in the Columbia, Clackamas, and Rogue Rivers, is of a convincing nature, and it appears to fully warrant the expense necessary to continue the feeding and intelligent planting of fingerlings. Upward of 68,000 pounds of fish food was used at the stations in the Oregon field during the fiscal year 1921. The details are given in the table of fish food on page 75.

BAIRD (CALIF.) STATION AND SUBSTATIONS.

[W. K. HANCOCK, Superintendent.]

In this field are to be recorded a number of untoward circumstances resulting in a serious curtailment of the fish-cultural work. From the fall run of fish the aggregate egg collections for the entire field amounted to 7,910,000, as compared with 11,785,000 the preceding year, which included 1,349,700 eggs of the spring run chinook salmon taken in the McCloud River at Baird.

Racks were again installed in the McCloud River in time to intercept the spring run of chinooks, but no fish appeared. This is directly attributable to the dam erected in the Sacramento River at Redding for irrigation purposes. This dam had the effect of diverting into the irrigation ditches most of the water in the river during periods of low-water stages, and though an opening was left in the

dam to permit the passage of fish it was never effective. The matter of providing a suitable fishway was taken up with the California Fish and Game Commission, and at the close of the year the case was pending in the courts.

There was a very large run of fall chinooks in the Sacramento River, and while the early fall was marked by low-water stages it was estimated on November 15 that there were enough fish impounded at the Battle Creek substation to yield not less than 15,000,000 eggs. At Mill Creek the run was even larger, and the egg collections for that substation were estimated at not less than 30,000,000. Beginning November 20 several days of heavy rains occurred, bringing about flood conditions of unusual severity. Many miles of territory, including railroads and highways, were under water. The retaining racks at all points were destroyed and spawning operations abruptly brought to a close.

At the Battle Creek substation 2,450,000 eggs were taken, of which 504,000 were transferred to Baird for incubation and 20,000 shipped to central station, Washington, D. C., for exhibition. The remainder were hatched successfully, and 1,781,000 fingerling fish were planted in Battle Creek. At the Mill Creek substation 5,460,000 eggs were secured, of which 1,000,000 were shipped to Baird and 3,000,000 to the State hatchery at Sisson. From the remainder 1,347,400 fingerling fish were produced at the station.

INVESTIGATIONS AND EXPERIMENTS.

FERTILIZATION OF SALMON EGGS IN NATURAL SPAWNING.

At many points on the Pacific coast certain species of salmon, notably the humpback and chum, spawn at or near the mouths of streams in tidewater. A rather general belief has existed that the results of such natural spawning were negative, and in order to obtain information on the subject the field superintendent in charge of the Pacific coast stations and the superintendent of the Baker Lake (Wash.) station were detailed to investigate these conditions in Puget Sound. The report of their findings follows:

In conformity with instructions relative to securing information on the percentage of fertilization of salmon eggs in natural spawning, with special reference to the eggs deposited in places over which the tide ebbs and flows, an investigation was made of Walcott Slough, at Brinnon, Wash., on March 5, 1920.

Walcott Slough runs through extensive tide flats, which at flood tide are completely covered with salt water. During ebb tide a good flow of fresh water, estimated at about 3,000 gallons per minute, passes through the slough, its source being spring seepage at the slough head. The fish—chum salmon with a few silver salmon—enter this slough to spawn, the entire slough bottom being composed of gravel suitable for the purpose. The bureau has a rack and trap installed at a favorable point in the slough, about 500 yards from salt water, where fish are captured for propagation. Below the rack some natural spawning occurs, and this occupied our attention. Several nests were investigated, all but two of which contained eggs. These two might possibly have been made last year, though they had the appearance of being used quite recently. Eight nests were examined, beginning with No. 1 (see table, p. 28) just below the trap, about 500 yards from salt water at low tide, and ending with No. 8, about 200 yards from the same water stage. During flood-tide periods salt water covered the nests from three to six and three-fourths hours to a depth of $1\frac{1}{2}$ to $5\frac{1}{2}$ feet. This will vary somewhat with higher or lower runs of tide.

The condition and character of the bottom wherever nests were found would indicate that the fish chose points where spring seepage occurs through

gravel from 1 to 4 inches in diameter. Here the eggs were buried from approximately 8 to 16 inches deep. When the eggs were reached, the gravel was found to be absolutely clean, more especially where the good eggs were secured, with a coating of fine sediment on top, indicating a circulation of fresh spring seepage water at all times. Anticipating this condition, a common trough was installed in the slough, with a circulation of fresh water assured at a low tide, but which at flood periods would be covered from 1½ to 4 feet with salt water without any circulation. The trough was filled with gravel, through which about 25,000 eggs were carefully mixed. A tight cover was then fastened on the top, with sufficient space left at both ends for proper circulation. The eggs were placed in the gravel on December 18, 1919, immediately after being fertilized, and on examination, on March 5, 1920, they were found to have hatched with an estimated loss of about 30 per cent. The fry appeared to be extremely active and healthy. The bad eggs were nearly all decayed and broken but had the appearance of having been fertilized and the embryo partially developed.

This would lead us to believe that an entire salt-water supply, with as low a density as 1.010 for an extended period, is injurious but not absolutely fatal, and it strengthened our belief that where fish spawn naturally within tidewater area the eggs are deposited where they receive a circulation of fresh water, as before stated. Samples of eggs were taken from each nest, and, contrary to Mr. Robertson's theory and observations in hatching eggs in gravel, the infertile eggs were chalky white when first observed in the gravel. The alternating salt and fresh water may be a contributing cause, though where a continuous circulation of fresh water seeps through the gravel it would appear difficult for salt water to penetrate sufficiently to have much influence on the eggs.

Our observations led us to believe that the infertile eggs might be accounted for largely by a scarcity of male salmon. However, there is a possibility that spawning might have occurred wholly in salt water, which may prevent the action of the eggs necessary to proper fecundation. As all but a few of the fish entering the slough were taken in the trap, and as the males are usually the first to ascend, it is not improbable that most of the males entered the trap, thus reducing the possibility of successful natural spawning at the points where observations were made. The table would indicate enormous losses through natural spawning, but as conditions were not absolutely normal, we would not care to be too emphatic from this meager survey.

To obtain full information relative to the foregoing it would be necessary to extend observations over the entire spawning season. Each nest should be marked and accurate data produced as to the number of fish depositing in each nest, together with all natural and unusual occurrences noted.

RESULTS OF EXAMINATIONS OF FISH NESTS, WALCOTT SLOUGH, BRINNON, WASH.,
MARCH 5, 1920.

| Nests. | Distance from salt water at mean low tide. | Height of tide over nest at mean high water. | Water density, high tide. | Vertical rise of tide on reaching nest. | Length of time tide covers nest. | Estimated number of eggs per nest. | Condition of eggs. | Remarks. |
|------------------------|--|--|---------------------------|---|----------------------------------|------------------------------------|--------------------|--|
| | Yds. | Ft. In. | | Ft. In. | Hrs. | | | |
| No. 0 box ¹ | 550 | 1 7 | 1.018 | 7 8 | 3 | 25,000 | Hatched... | Estimate 70 per cent hatched. |
| No. 1, ² | 500 | 2 5 | 1.022 | 6 8 | 6 | 46 | Good..... | 41 good; 5 dead. |
| No. 2, ² | 450 | 2 1 | 1.022 | 7 0 | 4½ | 100 | Total loss.... | Unfertile. |
| No. 3, ² | 450 | 2 1 | 1.022 | 7 0 | 4½ | 151 | Perfect.... | 1 dead, but all fertile. |
| No. 4 ³ | 420 | 3 1 | ..... | 6 0 | 6½ | 500 | Total loss.... | Unfertile. |
| No. 5 ⁴ | 410 | 3 1 | ..... | 6 0 | 6½ | 200 | do..... | Do. |
| No. 6 ⁴ | 300 | 4 7 | ..... | 5 6 | 6½ | 402 | Very poor. | 400 dead; 2 good (bad, unfertile). |
| No. 7 ⁴ | 250 | 4 7 | ..... | 5 6 | 6½ | ..... | ..... | Nest looked good, but contained no eggs. |
| No. 8 ⁴ | 200 | 5 7 | ..... | 3 6 | 8 | ..... | ..... | Do. |

¹ The salt water density was tested by pumping water from bottom over nests at flood tide and ranged from 1.018 at box location to 1.022 at nests Nos. 1, 2, and 3, and 1.025 natural sea water in Hood Canal.

² Planted.

³ Nests 5 feet apart.

⁴ Current swift and water badly discolored; numbers estimated from those seen in the water and caught in net and baskets set below the nests on the riffles when disturbing eggs; good eggs are not as buoyant as dead ones, and therefore some may have escaped our notice.

HATCHING EGGS IN GRAVEL.

At the Afognak (Alaska) station an experiment in hatching eggs in gravel after the so-called Robertson method was undertaken during the season of 1920. Eggs to the number of 5,500,000 were placed in two old hatching troughs, mixed thoroughly with gravel, and bedded in the bottom of the creek. The troughs were fitted with a cover and water was introduced through a 1-inch pipe leading from a small dam, so that there would be a gradual flow through each trough. The intake of this pipe was carefully protected by a screen.

On opening the troughs in the spring it was found that very few of the eggs had hatched. Though the winter was a mild one it is probable that the eggs had been frozen, as there had been a very light fall of snow, leaving the creek unprotected, and frost may have penetrated to a greater depth than in seasons of lower temperature. Eggs placed in gravel boxes patterned after the Robertson plan and held in the hatchery developed nicely, and the majority of the fry remained in the gravel until the yolk sac was absorbed.

SUGGESTIONS FOR POSSIBLE IMPROVEMENT AND ENLARGEMENT OF WORK.

Further extension of the feeding operations at all stations where chinook, sockeye, and silver salmons are handled is desirable. This would necessitate an increased allotment for the Pacific coast work, since at the present time there is not sufficient capacity or funds to feed all stock resulting from the eggs collected. In fact, it has been necessary to close certain substations and curtail expansion in all fields. The extension of operations in other fields is essential if the work is to be kept at its highest efficiency. The take of eggs at many of our stations has been reduced through extensive commercial fishing operations during the period of the war, when heavy demands were made for this class of food, and it will take many years to restore the streams to their former productiveness.

The small statutory salaries provided for the lower grades of the bureau's service and the consequent inability to maintain a trained and efficient personnel have been important factors in the declining output. Because of these conditions it has been necessary to employ and train new men at most points every season, and as competent men could not be secured or retained at the statutory wage provided station allotments have been drawn upon in many instances for the employment of temporary help at the prevailing high wages, thus greatly reducing the funds available for actual propagation work.

The returns from the marking of young salmon on the Columbia River and at other points have not been wholly satisfactory. One reason for the small returns from these experiments may be the fact that it has been the custom to hold the fish intended for marking for several months beyond the natural spring migration, and this may have had a serious effect on the life of the fish involved. The thought has occurred that better results might be secured if the fish used in the marking experiments are held over one year, or until the migration of the following spring. The results of the marking experiments also suggest the desirability of a more thorough study of the early life of the salmon, with the view of correcting any possible weaknesses in present methods of propagation and distribution. This is a phase of the work that is respectfully referred to the division of scientific inquiry.

One of the greatest needs in connection with Pacific salmon propagation is more adequate protection for the fisheries through the enactment and rigid enforcement of restrictive legislation. The regulations should provide (1) for the return to the waters uninjured of all immature fish that may be taken in nets or other fishing devices; (2) for a weekly closed season, thus assuring ascent to the natural spawning grounds of a certain proportion of the unripe fish; (3) for cessation of fishing operations after the canneries have put up a fixed number of cases, the limit of the pack to be determined by investigations in each locality, which must be such as will permit the escapement of a sufficient number of fish to insure continuation of the run in each locality; (4) for systematic destruction of Dolly Varden trout in salmon streams, these fish having been found to be among the greatest enemies of young salmon; (5) for setting aside natural lakes for use as salmon-rearing reservoirs; (6) for seeding of eyed salmon eggs in the more inaccessible lakes, in order that the young may pass the early stages of their existence in waters which are comparatively free from natural enemies. During periods of flood the fish in these lakes would pass from them over slight falls and through the intervening rapids, entailing little loss. In certain barren lakes the application of such a plan would necessitate the provision of a food supply. Work of this character has already been undertaken in a limited way in the vicinity of the Yes Bay (Alaska) station.

The tray system recently introduced in connection with the propagation of salmon at the western stations is proving a very important factor in the work. The eggs are carried in the regular baskets until within two or three weeks of the hatching period, when they are transferred to 14 by 16 inch trays, made of 1 by 1½ inch lumber and covered with wire cloth 14 to 16 meshes to the inch. From 3,500 to 4,000 sockeye-salmon eggs are placed on one of these trays. The trays are stacked from 6 to 8 deep in a trough compartment, thus increasing the holding capacity of a 16-foot trough from six to eight times and permitting the safe development of 300,000 to 400,000 fry in a space which was formerly required for 50,000. The fry are carried in dark, deep pockets, with the view of providing, so far as possible, the seclusion afforded in natural hatching, as it is believed they will develop under such conditions all the characteristics of gravel-hatched fry.

Another favorable feature is the more compact arrangement of the hatching apparatus, which permits of a much better control of the fry than under the basket and open-trough system. While it is entirely practicable to spread the green eggs on the trays directly and continue using them throughout the incubation period and up to the time the fry are ready to be fed, it has been found more satisfactory to carry the eggs in the baskets to the point of hatching and then transfer them to the trays, as such an arrangement permits of a thorough cleaning of all apparatus involved. Writing in regard to the use of this system, C. H. Van Atta, superintendent of the Yes Bay (Alaska) station, states:

Sixty thousand sockeye-salmon fry were placed on 12 trays, each 13½ by 25 inches in dimensions. The trays were stacked in one regular basket com-

partment of the hatching trough and held thus from March 12 until the yolk sac had been completely absorbed, on June 7. The total loss of fry during this period was 180.

Without the trays only about 50,000 salmon fry can be safely carried in a standard 16-foot hatching trough through the sac stage. It would therefore appear that by the use of this system the fry capacity of each trough is increased by approximately 200 per cent. J. R. Russell, superintendent of the Baker Lake station and its auxiliaries, in the State of Washington, writes:

The stacked tray system for holding fry during the sac stage was tested this year for the first time, 1,000 of the trays being in use at the Baker Lake hatchery, with 11,000 fry to a tray and 4 trays in each basket compartment, making a total of 264,000 fry per trough. The system proved an entire success. The loss was small. The danger from smothering, which sometimes occurs when large numbers of fry are held on the trough bottoms, appeared to be entirely eliminated, and the "paddling" of the fry, which is essential in the trough, is rendered unnecessary.

From this statement the trough capacity appears to be even greater than was indicated by the experiment at the Yes Bay station. During a period of water scarcity at the Baird (Calif.) station the trays were successfully used to economize in space and water.

PROPAGATION OF FISHES OF THE GREAT LAKES.

The bureau's work in the propagation of the commercial species indigenous to the Great Lakes extends from the Rainy Lake region, in Minnesota, to Lake Champlain, in Vermont. Under existing conditions the work in this field fails of its fullest efficiency through a lack of adequate facilities. An example of this condition is suggested in the possibilities that exist in the propagation of pike perch. In the Rainy Lake field, where pike-perch propagation has been tried in a tentative way, arrangements may be concluded with the Minnesota Fish and Game Commission for the establishment of a small inexpensive hatchery, to be operated jointly by the bureau and the State as an adjunct of the Mississippi Valley work.

Another important pike-perch field awaiting development is in Saginaw Bay, Mich., this region offering greater returns for a given expenditure of funds than any other of which the bureau has knowledge. With an inexpensive but well-equipped hatchery, located in the lower section of the bay, the bureau would be in a position to save the immense numbers of eggs—estimated to be over a billion a year—which are now being sent to market in the fish and lost.

At the pike-perch substation located near the head of Lake Champlain, at Swanton, Vt., large numbers of pike-perch eggs are lost every spring because of inadequate facilities. Before any appreciable improvement can be expected at this station it will be necessary to provide an efficient penning system, so that the large numbers of partially ripe fish taken by commercial fishermen may be held under favorable conditions awaiting the full development of their eggs.

So far as the propagation of whitefish, lake trout, and cisco (lake herring) is concerned, there has been no notable change in recent years either in methods pursued or the fields occupied. Probably the greatest improvement in this branch of the work, both as regards

equipment and extent of territory covered, has been in connection with the operations at the Cape Vincent (N. Y.) station. Within the past year the capacity of the hatchery at that point has been increased approximately 150 per cent without increasing the floor space, this being made possible by the construction of a new and compact type of battery for the glass jars used in the incubation of these eggs. A cut of the battery showing the placing of jars and other details is shown herewith in Figure 1. The scope of the station's field operations has been materially enlarged through close cooperation with the New York Conservation Commission and the Dominion and Provincial fisheries authorities of Canada. At the present time the most prolific field occupied is in the vicinity of the Bay of Quinte, on the Canadian side of Lake Ontario.

The great need in all branches of fish conservation is effective, stringently enforced protective legislation. Simple, easily understood, and easily remembered fishery laws are always desirable, but in the Great Lakes regions the fault probably lies not so much in the character or wording of present laws as in the lax enforcement of legislation now on the statute books. A close season, varying in length to meet local conditions, should be established for all species in the Great Lakes region, and no commercial fishing should be permitted until 40 per cent of the fish on the fishing grounds are in spawning condition, this fact to be determined by the use of set nets operated under supervision. The State laws should provide that commercial fishermen operating during the spawning period be required to turn over free of charge to designated agents of the bureau or the State the ripe eggs of all fish taken. In the framing of the laws more stress should be laid upon the legal size of fish than upon the size of the mesh of seines or nets, and a moderate percentage of small fish should be allowed. In connection with this feature of the work the importance of uniform laws governing all persons alike in a given locality is not to be overlooked. In order to bring about the greatest good, such laws must in their application be not only interstate but international.

The aggregate output of this group of stations, including the hatchery on Lake Champlain, where pike perch and yellow perch are propagated, amounted in round numbers to approximately 1,158,000,000 eggs, fry, and fingerlings, as against 886,000,000 in the preceding year. The increase may be attributed largely to more favorable weather conditions prevailing throughout the spawning seasons of the species handled. By way of contrast in climatic conditions as they affect fish culture, the work in the Great Lakes region during the spawning season of 1920 suffered generally from severe cold and violent storms. During the spawning season of 1921, while stormy weather was encountered at certain points, the work was interfered with principally by unseasonably warm weather, resulting in water temperatures too high for the best results in artificial incubation.

This branch of fish culture has for many years received the heartiest support of the interests most directly benefited by the work, and that these interests still have faith in the efficacy of artificial propagation is evidenced by the many letters received from them, commending the work and urging its extension. While the figures given for the output of the Great Lakes represent largely such commercial

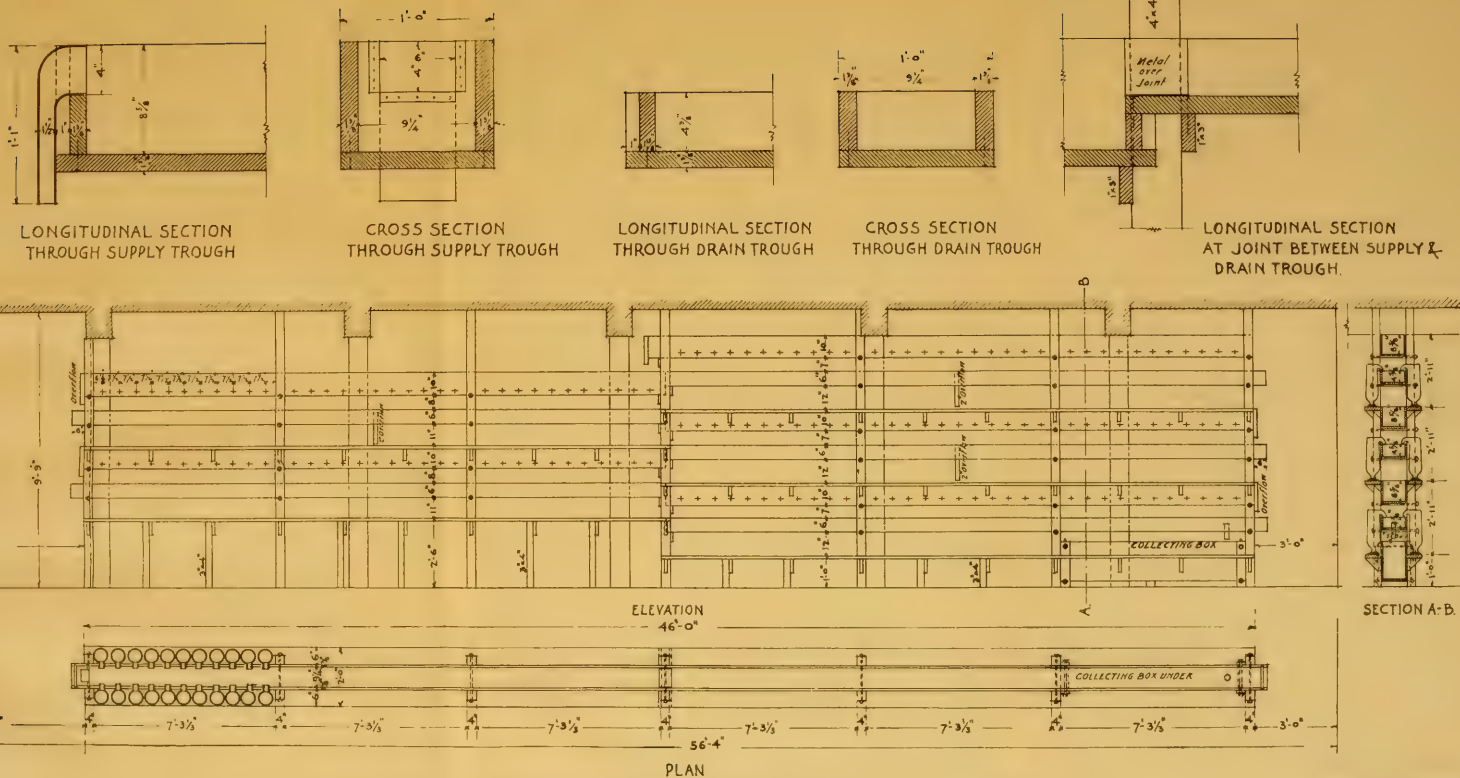


FIG. 1.—Plan of hatching battery in use at the Cape Vincent (N. Y.) station for the incubation of white-fish and cisco eggs. (Designed by J. P. Snyder.)

species as the whitefish, lake trout, cisco, pike perch, and yellow perch, they also include brook trout, rainbow trout, and smallmouth black bass, which species are produced in limited numbers at several of these stations.

DULUTH (MINN.) STATION.

[S. P. WIRES, Superintendent.]

The spawning season of the lake trout in Lake Superior fields, on which the Duluth hatchery depends for its stock of eggs, began about four days later than usual at nearly all points, the bulk of the eggs being taken between October 17 and November 1, though in the vicinity of Isle Royale, Mich., small lots were secured at intervals from the last week in September to about the middle of November. The run of fish was irregular and the egg collections light, the total aggregating only 12,726,500, or little more than half the take of an average season. On account of unseasonable weather and water conditions, poor transportation facilities, and a lack of ice at some of the more isolated fisheries, the quality of the eggs obtained was so impaired as to cut down the output of lake trout from this station to a total of 6,379,500, of which 175,000 were eyed eggs, shipped on assignment to other hatcheries, 6,057,000 fry, and 147,500 fingerling fish.

In the course of the lake-trout spawning season 940,000 whitefish eggs were collected in the Isle Royale field, and on January 6 this number was augmented by the receipt of 10,000,000 eyed eggs of very good quality from the Put in Bay (Ohio) hatchery. The combined stock yielded an output of 9,600,000 fry, all of which were planted in good condition, in various parts of Lake Superior. The station also distributed the product of 150,000 brook-trout eggs received from a commercial hatchery in New England and two consignments of rainbow-trout eggs, aggregating in the neighborhood of 100,000, the latter being transferred to the station from western hatcheries of the bureau.

In cooperation with the Minnesota fisheries authorities the force of the Duluth station established and operated two field stations for the collection of pike-perch eggs during the spring—one on the Rat Root River and the other on Boy River, a tributary of Leech Lake. The bureau's share in the proceeds of these operations amounted to 13,680,000 eggs. At Boy River the work was not altogether successful, as more than 98 per cent of the fish taken had deposited their eggs previous to capture. This may have been due to the unusually low water stages that obtained in the early part of the season, the fish not being attracted to the streams and spawning in the shallow waters of Leech Lake.

NORTHVILLE (MICH.) STATION AND SUBSTATIONS.

[W. W. THAYER, Superintendent.]

There was a further decrease in the number of whitefish and lake-trout eggs secured from Lakes Michigan and Huron, two causes for which are assigned—the State laws and inexperienced and unreliable spawn-takers. Under the present laws fishermen are permitted to use an unlimited number of nets during the fishing season and are not required to make any provision for the salvage of ripe eggs taken.

The effect of this is that so many nets are operated by the fishermen that they are not able to lift them at proper intervals, and the fish taken are either dead or the quality of their eggs impaired. During the spawning season in the fiscal year 1921 there was a good catch of fish and weather conditions were generally favorable, but for the reasons stated the egg collections were unsatisfactory, both as to quantity and quality. This applies to both the lake trout and the whitefish. The egg collections amounted to 30,876,000 of the lake trout and 12,080,000 of the whitefish, and all of them were incubated at the Charlevoix hatchery. The loss on the former amounted to 59 per cent and on the latter to 51 per cent. The output of the station was augmented by the transfer of 59,120,000 whitefish eggs from the Put in Bay station and 25,000 steelhead eggs from the Birdview (Wash.) field, the fry from both lots entering into the general distribution.

The pike-perch work on Saginaw Bay was fairly successful, but it does not represent by any means the potential value of this region as an egg-collecting field. The spawning season extended from March 26 to April 16, during which period 284,290,000 eggs were taken. Of this number 54,050,000 were deposited on the spawning grounds after being fertilized and 223,200,000 were sent to the Detroit hatchery of the Michigan Fish Commission for incubation. The importance of the work in this field has been mentioned on several occasions and funds should be forthcoming to place hatchery facilities in this field for the full development of the work.

From the Northville station there were distributed 475,000 brook-trout fry and fingerlings, resulting from eggs purchased of commercial fish-culturists, and 90,500 rainbow trout were produced from eggs transferred from the West Virginia and Missouri stations of the bureau. Approximately 31,200 smallmouth black bass reared from the Northville station brood stock were also distributed, and at the close of the year there remained in the station ponds about 75,000 bass and 2,000 rainbow-trout fry.

PUT IN BAY (OHIO) STATION.

[S. W. DOWNING, Superintendent.]

Owing to quite generally favorable weather conditions in Lake Erie and to the close cooperation of the commercial fishermen, the whitefish work of the Put in Bay station resulted very satisfactorily, though the spawning season was unusually late. Between November 20 and December 12 eggs to the number of 376,500,000 were collected from fishermen operating in the various fields and placed in the Put in Bay hatchery. Of these, 141,060,000 were secured in the vicinity of Port Clinton, Ohio; 93,840,000 at Isle St. George; and smaller numbers from the fisheries around Toledo, Middle Bass Island, and Catawba Island. In the former prolific whitefish field near Monroe Piers, Mich., no eggs whatever were obtained, as fishing operations were brought to a close very early in the spawning season by a heavy and protracted wind and rain storm which came on just as preparations had been completed for the penning of the partially ripe fish. Shipments of green and eyed eggs aggregating 139,870,000 were forwarded to various State and Federal hatcheries and 7,000,000 fer-

tilized eggs were deposited on the reefs where taken. The remaining stock produced 167,500,000 fry, which were liberated on the spawning grounds in the lake, care being taken to scatter them over as wide an area as possible. The incubation period was shortened by the unusually mild winter, averaging only 119 days, in a mean temperature of $38\frac{3}{4}^{\circ}$ F.

The high-water temperatures prevailing during most of the winter brought on a run of pike perch in March, and some of the commercial fishermen reaped very good returns during the latter part of that month. No spawning fish were in evidence in March, however, and the run throughout the entire season was characterized by the very small number of spawners included in it. Egg-collecting operations extended from April 5 to April 24, but the number of eggs taken was proportionately small. Despite the fact that the fishermen were willing and anxious to act on any suggestion with a view to obtaining good eggs, the quality of the eggs was uniformly poor, being about the poorest, in fact, ever noted in eggs handled at the station. The total of 111,600,000 laid down in the hatchery yielded only 12,600,000 fry. These were strong and active, however, and the entire output was liberated in good condition on the spawning grounds in the lake.

Soon after the middle of May the carp propagation work, inaugurated two seasons ago in connection with the Port Clinton fisheries, was taken up, a small hatching battery for the purpose being set up in one of the fish houses at that point. During the egg-collecting period, extending from May 23 to June 11, spawn takers made daily visits to the fishing grounds to take eggs from the ripe fish landed in the seines, liberating at the same time the fry hatched from earlier lots. The catch of carp was below that of a normal season, but the egg collections were considerably larger than in either of the two previous seasons, the total amounting to 74,325,000. From this stock 63,325,000 fry were hatched and planted on the spawning grounds in the Portage River, between Port Clinton and Oak Harbor.

During the fall, arrangements were made with local fishermen on Lake Erie to save all smallmouth black bass taken in their seines and hold them in live boxes until a sufficient number could be secured to warrant a shipment. By this means 805 adult fish of that species were collected during October and forwarded to various pond fish-cultural stations of the bureau to serve as a brood stock.

CAPE VINCENT (N. Y.) STATION.

[J. P. SNYDER, Superintendent.]

During the first half of November lake-trout eggs to the number of 549,000 were taken at points on Stony Island, N. Y., and Pigeon Island, on the Canadian side of Lake Ontario. As is usual at that time of the year, stormy weather was encountered and all of the eggs were obtained during but four days of weather suitable for fishing. Thirty-nine thousand eggs were shipped to applicants, and of the 450,000 fry hatched from the remainder 80,000 were furnished for stocking interior waters in the State of New York and 370,000 were returned to Lake Ontario waters. Collections of whitefish eggs from Lake Ontario amounted to 150,200,000.

The collecting operations for both lake trout and whitefish were conducted in American and Canadian waters under the same co-operative agreement that was effective last season. In Canadian waters the work was handicapped by lack of a suitable boat, making it necessary to plant on the spawning grounds immediately after fertilization 29,650,000 of the eggs taken at Deseronto and Big Island. Canadian hatcheries received 30,000,000 of the eggs obtained, in accordance with the terms of the agreement; 29,300,000 were turned over to hatcheries of the New York Conservation Commission and 1,000,000 were diverted to the Washington exhibit. The remainder were incubated at the Cape Vincent station and the resulting fry planted in Lake Ontario waters. Egg collections of cisco (lake herring) from Ontario waters totaled 317,200,000, of which 73,200,000 were obtained in Canadian waters at Deseronto and Bygotts Point. The fisheries authorities of Pennsylvania and New York received 104,410,000 and 65,000,000, respectively; 17,100,000 fertilized eggs were planted on the spawning grounds, and the fry hatched from the remainder were returned to Lake Ontario waters.

During the spring a small number of brood yellow perch were obtained from trap nets set in the St. Lawrence River, and from the 15,000,000 eggs thus secured 11,000,000 fry were hatched and returned to the St. Lawrence River. A consignment of 8,000,000 eyed pike-perch eggs received from the Lake Champlain hatchery yielded for distribution 7,970,000 fry of excellent quality, an usually high percentage. In addition to the commercial species enumerated 150,000 rainbow-trout eggs from the bureau's Virginia station and approximately 450,000 brook-trout eggs from commercial dealers were incubated and the fry distributed to applicants in New York State.

A boat suited to the needs of the station was obtained by transfer from the Navy, but because of the time consumed in making needed repairs to motors was not available for service during the past season. When fully equipped, this boat will add much to the productivity of the station, being particularly valuable in connection with the whitefish and cisco work in Canadian waters.

SWANTON (VT.) SUBSTATION.

[A. H. DINSMORE, Superintendent.]

The work at this point is conducted cooperatively with the State of Vermont. During the operating season of 1921, extending from March 2 to May 10, pike-perch eggs to the number of 112,312,500, also 43,950,000 yellow-perch eggs, were secured for incubation. The winter being unusually mild, the Missisquoi River was open at an early date. Nets were set during the first part of March and hauled at frequent intervals at the various points to anticipate the presence of fish. The first pike perch were taken at Sandy Point March 25 and at Campbell's on April 4. Three trap nets were in operation at the mouth of the river, but the results from their use would not appear to warrant their continuance. All fish taken were immediately transferred to the inclosure for ripening, but because of low water stages, resulting in an improper circulation of water through the inclosure, the mortality was high, and all brood fish on hand were released on

April 20. A cold spell in April, following the warm weather of March, caused a protracted incubation period for the pike-perch eggs. In this connection it is interesting to note that while the egg collections were made during the period from April 6 to 20 there was very little difference in the dates on which any lot of eggs reached the eyed stage or completed incubation. The eggs were of extremely poor quality, the loss during incubation being in excess of 77 per cent.

Collections of yellow-perch eggs were in progress from April 21 to April 23. Of the 43,950,000 taken 12,000,000 were delivered to the State hatchery at Burlington, Vt. The remainder were incubated with but slight loss. Upward of 33,000,000 of the pike-perch eggs were shipped to applicants, 14,700,000 going to hatcheries in the State of Vermont.

PROPAGATION OF YELLOW PERCH, BRYANS POINT (MD.) STATION.

[L. G. HARRON, Superintendent.]

Fish-cultural operations were undertaken at this point on March 1, the work being addressed to the propagation of the yellow perch. Between the 3d and the 10th of March 18,226 brood fish were taken. Spawning occurred between the 10th and the 23d of March, resulting in a total collection of 172,630,000 eggs of excellent quality. Of these 2,600,000 were shipped to Washington, where they served as an exhibit during incubation, the fry being used to supply applicants in Virginia. The remaining eggs were incubated in the hatchery, producing 158,819,450 fry, which were planted on the spawning grounds.

MARINE FISH CULTURE.

The season's work in this field may be considered satisfactory, the output of eggs and fry comparing favorably with that of the year previous. While there was a falling off of nearly 50 per cent in the output of cod as compared with last year, this is compensated for by satisfactory increases in the production of other species, notably the haddock. The work during the past season was extended to include the pole flounder (*Glyptocephalus cynoglossus*), a species not previously propagated. This fish, locally known as the "gray sole," has only recently been introduced in the markets of New England. Its existence in these waters has long been known, but previous to the use of the otter trawl in the shore fisheries it was not generally known to fishermen. Because of its small, weak mouth it was not taken on the trawl lines. It has since proved to be a popular fish, commands a high price in the markets, and a fishery of importance is being built up in connection with it.

Inadequate funds have prevented the development of possibilities for valuable work in the conservation of the large number of eggs of the marine fishes that are annually lost in connection with commercial fishing. Such work has now been undertaken on a limited scale by placing spawn takers on the fishing vessels operating in the offshore fisheries, to strip the mature eggs from the fish taken, fertilize, and return them immediately to the water. The work is considered of special value, since it deals with the conservation of vast quantities of eggs of the cod and haddock which have heretofore been annually destroyed.

BOOTHBAY HARBOR (ME.) STATION.

[E. E. HAHN, Superintendent.]

Fish-cultural work at this station during the year was addressed to the winter flounder and the pollock and resulted in an output of 841,235,000 and 11,906,000 of the respective species. The pollock fry were produced from eggs collected in the Gloucester fields and represent the first really successful attempt to make long-distance shipments of pollock eggs. Collection of flatfish eggs was commenced February 23 and continued to April 22. A total of 6,298 female brood fish were handled during the season and yielded 906,696,000 eggs. Though weather conditions favored the work, the spawning season ended earlier than usual, and because of this circumstance the take of brood fish was smaller than had been anticipated. On the other hand, the female fish taken were above the average in size and yielded a correspondingly large number of eggs. Some experiments in the rearing of the fry were conducted but without marked results.

A careful watch of the local fishing grounds where a limited number of boats engage in a spring fishery for cod and haddock was maintained with the view of obtaining eggs. The results were negative, however, as has been the case for several seasons, no fish in spawning condition being taken. Similar results followed a continuation of an effort to locate spawning areas of the alewife in the Damariscotta River and other points in the vicinity of Boothbay Harbor.

The steamer *Gannet* has been connected with the work of this station and has rendered valuable assistance in fish-cultural operations, particularly in the flatfish work, also in transporting men and supplies in connection with the repairs that have been made to the lobster pound at Pemaquid, Me.

GLOUCESTER (MASS.) STATION.

[C. G. CORLISS, Superintendent.]

In this field the output of pollock fry has for a number of years been larger than that of any other species propagated. With the general adoption of the gill net for taking pollock in the shore fishery and the prevailing high prices, this fish, which was formerly of minor importance, has come into high favor. During the calendar year 1920 more than 4,000,000 pounds of pollock, valued at \$118,502, were landed fresh at Gloucester, Mass., approximately 3,745,000 pounds of this amount having been taken in the shore fishery. In 1921, the pollock spawning season extended from November 15 to January 21, and the egg collections aggregated 650,850,000 as compared to 954,800,000 the preceding year. In the course of the fishing season there was a rather sharp decline in the market price of pollock, which resulted in the withdrawal of many boats from this line of work. The weather throughout the spawning period was exceptionally good, and to this fact the higher quality of the eggs obtained is attributed. Twenty-four million of the eggs were transferred to the Boothbay Harbor (Me.) station, and the remainder produced 443,160,000 fry, which were distributed on the pollock spawning grounds.

A rather unusual occurrence connected with the pollock work is the fact that the fish apparently sought new spawning grounds during the season. Heretofore practically all of the spawning fish have been taken in Massachusetts Bay, and all fish taken from spawning grounds to the eastward of Cape Ann have been barren of eggs. This year, however, large numbers of eggs were obtained from fish caught on the grounds lying from 20 to 30 miles eastward of Cape Ann.

The season's collection of cod eggs fell considerably below last year's established record collection of 570,704,000. Two reasons are ascribed for the falling off, (1) the comparatively small run of fish on the shore spawning grounds, and (2) the low market price for cod. Eggs were taken between January 15 and April 29, the total amounting to 210,040,000. Of these 151,530,000 were planted on the spawning grounds immediately after being fertilized, this method being resorted to at times during the spring months, when the low density of the sea water does not permit of making transfers to the hatchery. In addition to the local collections cod eggs to the number of 8,700,000 were transferred to Gloucester from the Woods Hole hatchery. The fry distribution from the station amounted to 50,900,000.

Propagation of the haddock at the Gloucester station was eminently successful and is represented by a record collection of eggs of that species. The causes contributing to this result were favorable weather, an abundance of fish on the spawning grounds throughout the season, and the comparatively high market price for haddock. The price was an important factor in attracting to this fishery a large number of fishermen who ordinarily follow the cod or other lines of fishing. The spawning period extended from January 22 to April 25, and 629,120,000 eggs were taken. Of these, 182,120,000 were deposited on the spawning grounds for the reason stated above.

Since the mild winter suggested the probability of an early spawning season for flatfish, nets were set as early as February 2 for the capture of a brood stock, but no fish were secured until March 14. During the first week of the season the take of adult fish was unusually large, giving promise of a fine egg collection. With the beginning of active commercial fishing, however, the collection of fish for propagation work fell off rapidly, and the season's operations resulted in obtaining only 154,740,000 eggs. From this stock 132,070,000 fry were hatched and distributed.

Because of the prominence the pole flounder has attained in the New England markets in recent years and the constantly increasing number of fishermen engaged in its capture, an investigation of the spawning habits of the fish was made with the view of undertaking its artificial propagation in the event that course seemed advisable. At the present time commercial fishing for the pole flounder begins in midwinter some 15 miles off Cape Ann. The fish appear to work slowly inshore, and by July fishing for them is in progress in the shoal waters of Ipswich Bay. The average daily catch per boat is from 8,000 to 12,000 pounds.

Large numbers of the fish were examined in April, but no ripe spawn was found until May 22. From that date until June 30, when the work was brought to a close, 19,410,000 eggs were taken,

fertilized, and planted on the spawning grounds. The eggs of the pole flounder are about one-twentieth of an inch in diameter, a liquid quart containing approximately 426,000. They are semi-buoyant and nonadhesive. It is probable that spawning continues throughout the summer months. It would appear that the species is worth the attention of fish culture, and that considerable numbers of eggs for artificial propagation are obtainable in the commercial fishery at comparatively small expense.

WOODS HOLE (MASS.) STATION.

[W. H. THOMAS, Superintendent.]

At the approach of the cod spawning season at this station negotiations were entered into with fishermen operating vessels equipped for carrying live fish to supply brood cod for the propagation work, but as only one suitable vessel was available the number of fish secured was smaller than was desirable. The first consignment of 485 fish was delivered on November 15. Five further consignments delivered between that date and December 6 brought the total brood stock up to 2,441 fish, all of which were placed in the spawning cistern. Stormy weather prevented any further deliveries. The fish were an exceptionally fine lot, a large percentage being females. For several seasons heretofore cod propagation at the Woods Hole station has been reduced to almost negligible proportions because of the very large percentage of barren fish among the brood stock. It is impossible to assign an entirely satisfactory reason for this condition, but it may have been due partly to the undersize of the fish and also to the fact that they were taken in places not usually frequented by spawning fish. The fish secured this season were of good size and were taken on fishing grounds located some distance offshore. The egg returns from them were very satisfactory, the total amounting to 214,702,000. Of this stock, 8,700,000 green eggs were transferred to the Gloucester station and 124,441,000 fry were hatched.

On account of more favorable weather conditions the results of the season's flatfish work were larger than those of the previous year, though the egg collections were not equal to that of the record year of 1918. Operations in local fields began on January 12 and resulted in a collection of 803,567,000 eggs. A very satisfactory increase in the number of fish obtained at Quisset Harbor is to be recorded. The collecting station at Wickford was opened March 18 and was in operation until March 28, when high-water temperatures made it impracticable to continue the work. The egg collections at this point amounted to 112,228,000, or less than half of last year's. From the total of 915,855,000 eggs obtained from all points fry to the number of 795,355,000 were hatched and deposited in local waters.

During March, 1920, the three-story frame building connected with the Woods Hole station, the first floor of which was occupied as a machine shop while the two upper stories furnished storage space for fish-cultural and scientific equipment, was destroyed by fire. A special appropriation of \$65,000 for rebuilding and replacing equipment was provided by Congress, becoming available June 5, 1920.

Advantage was taken of this opportunity in reconstruction to make certain changes in building and equipment that will add much to the

convenience and efficiency of the operations and also effect an economy. The new building, of fireproof construction, provides for a machine shop, boiler and pump room, garage, and ample storage space. The old boiler and pump room, of frame construction, constituting a further fire menace, has been removed. The new boiler space is adjacent to and connected with the coal shed by a covered passage, thus eliminating a long and expensive haul of coal from the storage to the boiler.

Another important change was the construction of a sand filter, with a capacity of 300 gallons of water per minute. The arrangements are such that the water from the cod-spawning cistern enters the filter by gravity. From the filter it is returned to the storage tanks by the pumps. "Make-up" water will be added each day in sufficient quantities to keep the supply in good condition. This will add to the efficiency of the fish-cultural work by eliminating from the hatchery the sediment that is carried in the water taken direct from the harbor and which has been particularly detrimental to the eggs under incubation during periods when the harbor water is agitated by high winds. The arrangement will be further effective in a saving of fuel, since it is found expedient to raise the temperature of the hatchery water supply from 8 to 10 degrees during the winter months. The new system will permit of the water that has been warmed being kept in circulation throughout the entire system. Modern heating apparatus, with automatic thermo controls and an electrically operated pump, for use during the summer when but comparatively small quantities of water are used, will effect a further saving in fuel consumption.

PROPAGATION OF BUFFALOFISH, ATCHAFALAYA (LA.) SUBSTATION.

[C. F. CULLER, in Charge.]

The propagation of buffalofish in the Atchafalaya River district of Louisiana is meeting with success, dependent to a large extent on the regulations recently established by the Louisiana Conservation Commission. Under existing arrangements no fisherman is allowed to operate nets during the spawning season without first securing from the State authorities a permit, which is revocable in the event that the eggs of all ripe fish taken are not delivered without charge to collecting agents of the bureau. It is considered that permission to fish during the closed season, with the right to retain the fish captured after stripping, is sufficient compensation for the eggs turned over to the bureau.

This work was inaugurated in the spring of 1918 to meet the large and increasing market demands for buffalofish, and while the water stages in the river during the spawning season are not uniformly favorable the experience gained has demonstrated that, with the local cooperative assistance at present afforded, there is no reason why hatching operations should not be continued on an extensive and profitable basis. Thus far the fishermen have willingly complied with the terms of the regulations, and the cooperation rendered by them has contributed largely to the success of the work.

In the season of 1921 the substation was opened on January 23 and, in order to free the hatchery water supply of the large amount of sediment contained in it, a filter was installed in the water-supply

line. No sand being available for the purpose, cinders were substituted, and to the presence of this material is attributed the loss of approximately 46,000,000 of the first eggs received. The removal of the cinders and the refilling of the filter with sand and gravel corrected the situation, though the output of the substation was considerably reduced.

The first eggs were taken on February 27, and during the spawning season, which ended on March 25, a total of 96,440,000 eggs were taken. Of these, 1,440,000 were planted on the spawning grounds after being fertilized and 38,600,000 fry were developed at the hatchery. The conditions were unusual, inasmuch as the Atachafalaya River was at a low stage until late in January, whereas a rise occurs in the late fall in more normal years, its effects continuing into the spring months. To this condition may be attributed the short season and the small numbers of fish on the customary spawning grounds. The water temperatures during the egg-collecting period ranged from 60 to 76° F. The incubation period was 10 days in a mean water temperature of 60°. The eye spots in the egg are visible to the unaided eye in from four to five days, and the fry have absorbed the umbilical sac in from four to five days after hatching.

Further counts and measurements to ascertain the correct number of eggs to a liquid quart were made and a standard of 120,000 was established as a result. Observations were made at several points to determine the percentage of fertilization that is attained in eggs deposited under natural conditions. The results varied from zero in certain places to as high as 40 per cent at others, with an average of 10 per cent at all points considered. Efforts were also made to secure information relative to the spawning of the paddlefish, but nothing of a reliable nature was gained.

Buffalofish propagation conducted on an experimental scale at Clarendon, Ark., has been permanently discontinued, it having been found that very few of the local fishermen are inclined to lend their cooperation.

PROPAGATION OF ANADROMOUS FISHES OF ATLANTIC COASTAL STREAMS.

Included under this head are the shad, glut herring, alewife, striped bass or rockfish, and the Atlantic salmon.

PROPAGATION OF SHAD, BRYANS POINT (MD.) AND EDENTON (N. C.) STATIONS.

The work addressed to the shad is conducted at only two hatcheries, Bryans Point, on the Potomac River in Maryland, and Edenton, on Albemarle Sound in North Carolina. It is interesting to note that the run of shad is being maintained in these regions, notwithstanding the failure to put into effect the greatly needed regulatory measures for which the bureau has worked. During the 12-year period from 1910 to 1921, both fiscal years inclusive, the Maryland hatchery distributed a total of 448,799,000 shad fry, an average annual output of 37,399,000. The total output of shad from the North Carolina hatchery during the same period amounted to

409,683,000, or an average annual output of 34,140,250. Practically all of these fry in each instance were distributed on local spawning grounds. In view of the conditions that exist in other shad streams where artificial propagation is not conducted, it seems but just to assume that the hatcheries have been a factor in maintaining the shad fisheries in their vicinity.

The bureau is frequently importuned by State officials and others to render assistance in restocking depleted shad streams by planting therein a portion of the output of its two hatcheries. In their efforts to obtain this assistance the illogical argument has been advanced that the shad hatcheries, being the property of the Federal Government and supported by public funds, should apportion their output in accordance with public demands and without regard to the source of supply. Were the bureau to be influenced by such reasoning it would result in dividing the comparatively small output of its two hatcheries among various States along the Atlantic seaboard. The numbers allotted in any instance would be negligible, and such a course would inevitably result disastrously to the fisheries in the waters in which hatchery operations are now conducted.

For many years the bureau followed the policy of making systematic plants of shad fry in the principal shad rivers and tributary streams along the Atlantic seaboard, but the results did not justify a continuance of such efforts, because the States concerned did little or nothing for the protection of the species, and with the rapid and constant increase in fishing operations and fishing devices the run constantly lessened. Finally, in order to maintain the dwindling supply in home waters the bureau found it necessary to discontinue shipments to outside points and return to the local spawning grounds the entire product of its shad hatcheries.

The status of the shad fisheries at the present time is precarious in the extreme, fully warranting the adoption of drastic measures if they are to be saved from total and early extinction. In spite of the discouraging situation, however, the States most nearly concerned have thus far appeared loath to take any decidedly aggressive action toward safeguarding or increasing the run.

While the falling off of the shad run in many Atlantic coastal rivers and their total disappearance in others are due to several causes, the chief factor involved would seem to be a total lack of protection during the spawning season. As a result of the extensive fishing operations near the mouths of such streams and in the salt and brackish waters below very few shad are able to reach their spawning grounds. The considerable amount of trade waste entering the streams has also had a deleterious effect.

The collection of shad eggs in the Potomac, at the Bryans Point (Md.) station, fell considerably below that of a normal season, amounting to only 15,620,000. During February and March the weather was unusually mild, with high water temperatures, the maximum in March being 64° F., with a mean temperature of 52° F. As a result, spawning shad were taken unusually early, and 316,000 eggs were secured during that month. Weather conditions in April were a reversal of those in March, with equally unfavorable results to the work, and the season was brought to an early close on May 9. Approximately 1,110,000 of the eggs secured were sent to central

station for an exhibit, and the resulting fry were returned to the Potomac River. The eggs retained for incubation at the hatchery produced 13,639,175 fry, all of which were deposited on local spawning grounds.

The conditions during the season were especially favorable to pound-net operations. The high water temperatures in March appeared to cause the shad in their upstream migration to leave the deep-water channels, which are unobstructed by nets, and seek the shallower water of the flats, thus coming in contact with the pound nets set to intercept them. In 1915 similar conditions prevailed, and that season and the one under discussion represent the only marked variations in the collections of shad eggs at this station in a long period of years.

Another factor bearing on the shad work in the Potomac River is the apparent increasing indifference of certain fishermen to the necessity for cooperating with the bureau by saving for propagation the eggs from the spawning fish taken by them. Most of the fishermen render this service willingly, realizing its value to them and to their industry, but the high prices paid for shad in recent years have evidently created among a certain class of fishermen a feeling that the only important consideration is to get the largest number of shad to market in the shortest possible time. This attitude has undoubtedly resulted in the loss of a very considerable number of eggs, and if it continues it may become advisable to invoke the aid of the Maryland and Virginia authorities. Since the shad fishermen are licensed by the State in which they operate, it would seem that a regulation might be put into effect that would require all fishermen taking shad on the spawning grounds within certain areas and in working distance of the hatchery to assist employees of the bureau in conserving the ripe eggs under penalty of a revoked license for failure to comply.

The first shad eggs for the Edenton (N. C.) hatchery were secured on March 28, and on May 5 the season ended with a total collection of 21,710,000 eggs. As at Bryans Point, climatic conditions were unfavorable for the best results, the fluctuating water temperatures being particularly annoying. A considerable reduction in the expense of collecting eggs was effected during the season by closer cooperative relations with the fishermen, a situation that the bureau has constantly endeavored to foster. One of the difficulties in obtaining shad eggs in this region is the large number of pound nets used. As such nets are lifted at infrequent intervals, the eggs of fish taken in them are seldom fit for incubation. Eggs of the shad appear to be at their best when taken from fish caught between sundown and midnight. For this reason gill nets, which are set on the ebb tide and lifted at half-hour intervals, constitute the most dependable source of egg supply for the Edenton hatchery.

The Edenton station also propagates pond fishes, mention of which is made on page 63.

PROPAGATION OF GLUT HERRING, EDENTON (N. C.) STATION.

The propagation of glut herring was taken up last season for the first time at Edenton, and the results obtained may warrant a continuance of the work. Some opposition was made by local fisher-

men on the ground that the stripping of the fish reduced their market value, an objection which is not altogether well founded. While it is true that the appearance of the female may be affected by the stripping process, the roe at spawning time has no market value. The spawning season of this species coincides with that of the shad, and for that reason the egg collections were limited, the hatching capacity permitting of a total collection of 56,130,000.

PROPAGATION OF ALEWIFE, BOOTHBAY HARBOR (ME.) STATION.

For the past two seasons attempts have been made to secure eggs of the alewife for artificial propagation at the Boothbay Harbor (Me.) station. The Damariscotta River supports a run of the species, and there is a fishery of some importance at Damariscotta Mills. An examination of the fish taken at this fishery in tide-water very soon disclosed that no fish with mature spawn were obtainable from this source. The efforts made to hold the fish in an inclosure, awaiting the maturity of the eggs, were not successful, and attempts to secure eggs from the fish after their entrance into fresh-water ponds above the falls were equally unsuccessful. Seines, pound nets, and fyke nets were employed at Damariscotta Mills and at West Boothbay Harbor in ponds where the alewife is known to spawn, but the results were negative in every instance in so far as they pertained to eggs for propagation, though considerable numbers of fish with immature eggs and also of spent fish were taken. No satisfactory explanation of this unusual situation is at hand, since alewives in spawning condition are taken in various forms of nets at other points.

PROPAGATION OF STRIPED BASS, WELDON (N. C.) SUBSTATION.

The bureau propagates the striped bass or rockfish at a single substation, located on the Roanoke River at Weldon, N. C., where a yearly average of about 12,500,000 fry is hatched and returned to the spawning grounds in the river. The work is greatly handicapped by the floods usually encountered and also by the difficulty experienced in securing ripe fish of the two sexes at the same time. During the height of the run this latter condition is less pronounced than it is earlier or later in the season. Contrasted with the output of some of the commercial species, the work at this hatchery is not large, but it is showing a steady and gratifying increase, as is evidenced by a comparison of the results of the past 10 years. The production of striped bass fry at Weldon rose from 5,256,000 in 1912 to 20,184,000 in 1921, an increase of nearly 400 per cent.

PROPAGATION OF ATLANTIC SALMON, CRAIG BROOK (ME.) STATION.

[J. D. DE ROCHER, Superintendent.]

For many years it has been the practice of the bureau to purchase in May and June practically all the salmon captured by the Penobscot River fishermen, estimating the average weight at 12½ pounds, and paying the prevailing market prices for them, together with a bonus of 60 cents per fish for careful handling. The fish have been held in a large lake or inclosure until their eggs were mature,

and after having been stripped they have been released in the river. Operations along these lines have resulted in the purchase of almost the entire catch and paying for the fish at a seemingly exorbitant price, this amounting in effect to the maintenance of the run for the sole purpose of furnishing employment to a few river fishermen.

After thoroughly canvassing the situation the bureau recently decided to curtail its expenditures in this direction, with the view of ascertaining if equally good results could not be brought about by less expensive methods. Taking all related facts into consideration, it would seem that the State of Maine should interest itself in providing efficient fishways over the dams which at present obstruct the passage of the salmon to their natural spawning grounds.

At the beginning of the fiscal year there were on hand 316 brood salmon, obtained by purchase from local fishermen in June. At the spawning season in October these fish yielded 911,720 eggs, from which 821,240 fry were hatched. On March 12, 1921, 600,000 eggs of this species were received from the New Brunswick hatcheries of the Canadian Government in exchange for eggs of the brook, rainbow, and blackspotted trouts. These were successfully incubated, producing 565,760 fry, all of which entered into the general distributions in Maine waters.

Propagation of Fishes of Interior Waters.

The serious inroads that have been made in the public waters of the interior as a result of the extensive and rapidly increasing use of the touring automobile are making it exceedingly difficult to maintain the fish supply in such waters. Recognizing the necessity for heavier stocking of their waters, many of the States have called upon the bureau for assistance, which, in view of its greatly overtaxed resources, it has not always been possible to extend. One of the greatest demands is for brook trout. The bureau does not produce its brook-trout eggs, but of necessity relies upon commercial fish-culturists for a large portion of its supply. In many instances such eggs can not be considered as more than a by-product of the commercial plants. They are, as a rule, taken from 2-year-old and 3-year-old fish and for that reason do not have the stamina that might be expected from the progeny of older fish. In view of this situation, Congress has been asked for sufficient funds to establish a plant for the production of the brook-trout eggs needed to fill the bureau's hatcheries. After placing it on an operative basis such a plant could be made to produce eggs of superior quality in numbers sufficient to meet the bureau's requirements and at a smaller cost than is now involved in the purchase of a poor grade of eggs.

The demand for smallmouth black bass can not be met by the hatcheries, the principal handicaps in the work with this species being unfavorable weather and insufficient pond space. Means for increasing the production of bass and other so-called warm-water fishes are again mentioned as being one of the most important requirements of the service. During a long period of time the output of such fishes has not kept pace with the demand, and to meet the deficiency the bureau has found it necessary to utilize for general

distribution a small percentage of the fishes rescued from the Mississippi River overflows. In recent years the demand for bass has increased, but funds have not been provided for increasing the production of the species at the fish-cultural stations. This has resulted in a tendency to draw more heavily on the rescue work to meet the demands, until the number of bass so diverted in the fiscal year 1921 amounted to approximately 43 per cent of the total number rescued. Any increased diversion of bass from this source is not advisable, and unless other means are found for an increased production of the fish-cultural stations a large number of applications must of necessity remain unhonored.

Of interest in connection with the fish-cultural work is the development in recent years of fish and game protective associations in practically all parts of the country. Composed as they are of the leading citizens of the communities in which they reside, their influence for the protection and conservation of the natural resources is of great benefit. Such organizations endeavor to obtain the services of men experienced in stocking local streams with fish life, and in many instances they maintain ponds at their own expense for the purpose of rearing young fish obtained from State or Federal hatcheries to a larger size than would be otherwise possible before planting them in public waters. The intelligent cooperation resulting from this movement is marked and is worthy of encouragement. Another favorable influence exerted by organizations of this character is an increased respect on the part of the general public for the State fish and game laws. It is the policy of nearly all such organizations to favor better protective laws, to demand of their members a strict observance thereof, and to urge the same line of conduct on all others with whom they come in contact.

Among the more important species propagated for the stocking of interior waters are the catfish; rainbow, blackspotted, and brook trout; crappies; largemouth and smallmouth black bass; rock bass; and sunfish. The results accomplished with these species by the various stations during the fiscal year 1921 are reviewed in the following discussion. Data concerning the spawning seasons are given on pages 73 and 74, and a tabulation of the amount and cost of fish food used occurs on page 76.

NEW ENGLAND SALMON AND TROUT STATIONS.

BERKSHIRE (MASS.) STATION.

[WILLIAM A. CASLER, Superintendent.].

Fish-cultural work at this station, which is located near the town of Hartsville, Mass., was confined to operations with the brook and rainbow trout. Between October 20 and November 10 brook-trout eggs to the number of 133,500 were collected from brood fish in the station ponds, and two lots of eggs, aggregating 322,500, were acquired by purchase from commercial hatcheries. As the station fish were old and somewhat imperfect through interbreeding, the quality of their eggs was poor and heavy losses resulted, both during the incubation period and at the time the fry were ready to take food. A heavy loss was also sustained on one lot of the commercial eggs

from the disease known as "bluesac." In each case, however, after culling out the defective stock no further trouble was experienced; and the distributions of young fish from the three lots of eggs comprised 296,825 healthy No. 1 and 2 fingerlings, with 34,000 fingerlings on hand at the close of the year.

From two lots of rainbow-trout eggs—one of 50,000 transferred from the White Sulphur Springs hatchery and another of 6,920 taken from the station fish—43,900 thrifty fingerlings were produced, of which 2,000 remained on hand at the end of the year. The spawning season of the rainbow trout at this station extended from December 22 to January 20.

CRAIG BROOK (ME.) STATION.

[J. D. DE ROCHER, Superintendent.]

In addition to the propagation of the Atlantic salmon, for which purpose this station was primarily established, it has an annual output of brook trout from eggs purchased of commercial fish-culturists. The distribution of this species for the fiscal year 1921 amounted to 1,085,000 fry and 23,625 fingerling fish. The year's distributions also included landlocked salmon fry and fingerlings to the number of 43,545, these fish being the product of eggs transferred from Grand Lake Stream. A detailed account of the work with the Atlantic salmon is contained in the section devoted to the anadromous fishes, page 45.

Having an abundant water supply of excellent quality, this station possesses opportunities for development as a trout-rearing center. At comparatively small cost its capacity may be increased to the point where it will alone adequately meet the requirements of that section of the country.

GREEN LAKE (ME.) STATION AND SUBSTATION.

[JOHN A. STORY, Superintendent.]

Perhaps the most important part of the work of this station is the propagation of the landlocked salmon. Operations addressed to this species are conducted at the main station, a substation at Grand Lake Stream, and an egg-collecting station on Fish River Lakes, the work at the latter point being done on a cooperative basis with the Maine Commission of Inland Fisheries and Game. At Fish River Lakes egg collections were made from Cross, Eagle, and Square Lakes Thoroughfares, aggregating 525,000. These were all delivered at the State hatchery for eyeing. Under the agreement 250,000 of them were reserved for planting in parent waters, while the remainder were divided equally between the bureau and the State hatcheries after being eyed. The lakes were at high level prior to the spawning season, with but little rain during that period. Under these conditions there was but little and a constantly decreasing current over the usual spawning areas. This is thought to have been a factor in the reduced egg collections, though whether or not it was the most important one it is hardly possible to say. A total of 336 male and 260 female fish were handled during the season, the first being taken on October 24 and the last on November 9.

The number of landlocked salmon eggs taken from Green Lake represents an average season. Pound nets were set at the mouth of Great Brook as usual, and 87 female and 49 male fish were taken, the first fish entering the trap on October 14 and the last on November 19. Eggs to the number of 220,300 were secured, of which 70,000 were shipped to applicants. From the remainder 122,120 fry were hatched and distributed.

Of the 317,200 eggs obtained at Grand Lake Stream 115,000 were shipped to other points and 184,400 were retained for parent waters. To the unseasonably warm weather, which continued through the late fall, and the consequent high-water temperatures the delayed and prolonged run of spawning salmon is attributed. Spawning fish were still being taken in small numbers daily, when a sudden temperature change, with danger from ice, made it necessary to discontinue operations. The adult fish taken this season were of a larger average size than is usual at this point. Several specimens weighing 6 and 7 pounds were taken, yielding an average of 1,600 eggs per fish. During July and August 79,000 fingerling salmon carried over from the previous year were liberated in Grand and Dobsis Lakes.

The work addressed to the propagation of smelt met with a fair degree of success. From the 8,000,000 eggs obtained 7,000,000 fry were hatched and liberated in local waters and 600,000 eyed eggs were shipped to applicants. Practically all of the eggs were obtained this season from natural spawning, the adult fish being confined in troughs until this function was performed, after which they were liberated and the eggs transferred to hatching jars. Comparative tests of this method of obtaining eggs as against artificial stripping seems to prove the superiority of the former method. Of 150,000 eggs taken by artificial stripping only about 15 per cent produced fry, while the percentage of hatch obtained from natural spawning was 95. It was noted, however, that the best results were obtained from fish that were about ready to spawn when taken. When held in confinement for more than 36 hours prior to spawning, eggs of a poor quality resulted. In one instance a trough in which approximately 500,000 eggs had been deposited was left undisturbed for observation after the removal of the adult fish. On the fourth day the eggs showed the effects of smothering, this condition, which is well known to fish-culturists, being brought about by improper aeration of the water. The dam at the outlet end of the trough was raised, thus subjecting the eggs to a more rapid flow of water and relieving the dangerous symptoms. These eggs completed incubation in 14 days, with a mean water temperature of 55.5° F., as against 20 to 27 days for the eggs incubated in Downing jars, with a mean water temperature of 46°.

In addition to the species already mentioned, brook-trout eggs to the number of 788,860 acquired by purchase from commercial dealers and 50,000 rainbow-trout eggs transferred from the bureau's Virginia station were received during the year. Fifty thousand of the brook-trout eggs were reshipped to the Grand Lake Stream substation. From the eggs of that species retained at Green Lake 608,050 fry were distributed. The rainbow-trout eggs underwent a rather heavy loss during incubation and produced only 26,000 fry.

The distributions from the Grand Lake substation consisted of 47,880 brook-trout fry, 115,000 eyed eggs of the landlocked salmon, 55,000 landlocked-salmon fry, and 79,100 landlocked-salmon fingerlings, with approximately 74,000 fingerlings of that species on hand at the end of the year.

NASHUA (N. H.) STATION.

[WALDO F. HUBBARD, Superintendent.]

The work at this station was concerned with the brook and rainbow trouts, pike perch, and smallmouth black bass. A few brook-trout eggs were obtained from brood fish at the station, but most of the eggs of this species were acquired by purchase. The rainbow eggs, with the exception of 16,638 taken from fish in the hatchery ponds, were transferred from the Wytheville (Va.) station, and the pike-perch operations consisted in the incubation of 2,000,000 eyed eggs shipped from Swanton, Vt. During the spawning season of the smallmouth black bass in Lake Sunapee, extending from June 2 to June 17, collections of fry of that species to the number of 31,700 were made and shipped to applicants. The work with the various species was conducted without unusual incident, and the output of fish for distribution is shown in the table on page 12.

ST. JOHNSBURY (VT.) STATION.

[A. H. DINSMORE, Superintendent.]

From this station as a center the usual field stations for the collection of brook-trout eggs were operated at Lake Mitchell and Darling Pond. Largely because of climatic conditions, the results of the work at both points were rather unsatisfactory. The egg collections amounted to 214,148 and 411,777, respectively, all of which were of the usual high quality.

During the summer of 1920 an investigation was made of the fish-cultural possibilities existing at points on the Big Margalloway and Little Margalloway Rivers and Parmacheence Lake, in northern Maine. As the field gave promise of satisfactory returns, a tentative plan was formulated for undertaking work in cooperation with the Northern Oxford Guides Association. The first eggs were taken October 13, and the collections, which extended to October 27, aggregated 300,000. As the main objects of the work were to build up the supply of trout in the local waters and to encourage the local organization in their fish-cultural activities, the bureau claimed only 50,000 of the eggs secured. The others were successfully incubated in the log hatchery put up by the association, and the resulting fry were planted, with but slight loss, in local waters. While the work was not particularly successful from a fish-cultural standpoint, the information gained will be useful in connection with any future work that may be attempted in that field.

At Lake Dunmore, Vt., a new field station was established for the collection of lake-trout eggs and was operated jointly by Federal and State employees. Eggs to the number of 130,000 were collected and sent to the Holden hatchery, another subsidiary of the St. Johnsbury station, to be eyed. After reaching the eyed stage half of them were turned over to the State fisheries authorities.

In accordance with past custom a considerable number of brook-trout eggs was purchased, and as usual they were greatly inferior to the eggs obtained from wild stock. Such purchases amounted to 377,800, and 56,000 eggs in addition were turned over to St. Johnsbury station by a Massachusetts dealer, with the understanding that half the resulting fry were to be placed at his disposal for sale to persons desiring fish for stocking private waters, the other half to be the property of the bureau. Two shipments of steelhead-salmon eggs, aggregating 58,000, were received from one of the Puget Sound (Wash.) stations, and a consignment of 25,000 landlocked-salmon eggs was forwarded from the Grand Lake Stream (Me.) hatchery.

Following the custom of past years, collections of smallmouth black bass fry were undertaken at Lake Tarleton, and though started some 10 days earlier than ever before they did not precede the unusually early spawning of the bass. High winds interfered with the work, making difficult the placing of screens and the dipping of the fish, and in some instances the screens were destroyed. Approximately 54,000 fry were obtained from this source and placed in ponds at the St. Johnsbury station for later distribution. This work at Lake Tarleton enables the bureau to secure limited numbers of bass for distribution in the Vermont field and at the same time assists in keeping down their numbers in the lake, where they are considered objectionable.

At the Holden substation approximately 350,000 brook-trout eggs were received, some from the field stations and some from commercial hatcheries, and the distributions of fry and fingerling fish from this lot amounted to 173,700, with 47,380 fingerlings on hand at the end of the year. The rather serious losses made evident by these figures are attributed mainly to an accident occurring on April 15, when the spring water supply to the hatchery was cut off. A more extensive system of aeration had been installed to overcome the losses occurring in recent years through defective aeration of the water. The new system promises good results, but because of this accident the evidence in its favor can not yet be considered conclusive. This substation also handled and distributed the product of approximately 145,000 lake-trout eggs collected at Lake Dunmore, Vt., 25,000 of the same species transferred from the Charlevoix (Mich.) field, and 50,000 rainbow-trout eggs received from the West Virginia hatchery of the bureau.

Work looking to the development of the York Pond (N. H.) site as a station for the production of brook-trout eggs was carried forward as expeditiously as the limited funds available for the purpose would allow. During the summer the small bottom west of the pond and the extensive flat below it were cleared and a small log cabin to house the employees was constructed. Officers of the Forest Service have rendered valuable aid in the work of developing this station. Through their efforts the camp has been provided with telephone connections, and they are planning for the construction of a wagon road to the site. They have also rendered assistance in running levels, with the view of turning the flow of one or more of the adjacent brooks into the pond system.

ROCKY MOUNTAIN TROUT STATIONS.

BOZEMAN (MONT.) STATION AND SUBSTATIONS.

[W. T. THOMPSON, Superintendent.]

Although the cold, stormy weather of winter was unduly protracted, interfering with fish-cultural work into the late spring months, a satisfactory season is to be recorded in this field. With Bozeman station as headquarters an auxiliary station is operated at Meadow Creek, in the Madison Valley, and substations in the Glacier National Park and the Yellowstone Park.

BOZEMAN (MONT.) STATION.

Fish-cultural work at the Bozeman station was confined to the incubation of eggs transferred from other points, these transfers amounting to 1,357,200 rainbow-trout eggs from Meadow Creek, 1,236,400 blackspotted-trout eggs from Yellowstone Park, and brook-trout eggs from the Springville and Leadville stations in the numbers of 350,000 and 782,000, respectively. Part of the rainbow-trout eggs were shipped to applicants and other stations; the remainder were hatched and distributed as fry and fingerlings to fill the demands for them in Montana, Wyoming, Idaho, Washington, and Oregon. Approximately 800,000 fry of the rainbow trout and black-spotted trout remained on hand at the close of the fiscal year.

MEADOW CREEK (MONT.) AUXILIARY STATION.

The Meadow Creek egg-collecting or auxiliary station was opened on April 9. The weather throughout the spring was cold and stormy, and there was no clearly defined run of fish, as is the case under more favorable conditions. The first rainbow trout appeared at the rack early in April, and the run continued at intervals up to June 10, during which period 2,273,000 eggs were taken. Of this number 1,357,200 were sent to the Bozeman station. The eggs taken during the latter half of the spawning season were of poorer quality than usual, probably because of the turbid water, which was materially affected by the storm conditions. The results of hatching were therefore disappointing, and of those retained for stocking home waters only 300,000 fry were realized. Near the close of the fiscal year 500,000 blackspotted-trout eggs were received at the Meadow Creek hatchery from the State hatchery at Anaconda, and these, with 30,000 rainbow-trout fry, were on hand June 30.

Mixed in with the rainbow-trout run were a limited number of grayling, though not sufficient to warrant spawn taking. The fish appeared to have been driven into the lake by the soft ice in the stream shortly after their appearance at the racks, the grayling evidently being very susceptible to influences of this kind. In recent years grayling have deserted the Meadow Creek spawning grounds, to which they formerly ascended in considerable numbers every spring. Whether or not the successful establishment of the rainbow trout therein is responsible for the abandonment of the stream by the grayling is conjectural, but the present spawning grounds of the fish in the region are unknown, though several attempts have been made to locate them.

YELLOWSTONE PARK (WYO.) SUBSTATION.

The spawning season of the blackspotted trout in the Yellowstone Park involves portions of two fiscal years. At the beginning of the fiscal year 1921 there were on hand in the hatchery 850,000 eggs which had been collected in June, and this number, added to the total obtained in July, gave an aggregate collection of 6,430,400 for the season. During the spring of 1921 the season was late, as at the Meadow Creek auxiliary station, and ice was still in Yellowstone Lake at the arrival of the spawning crews on June 10. The first eggs were taken at Fish Lake, near Soda Butte, on June 19, and at the close of the fiscal year the total egg collection numbered 1,747,500, of which 829,600 were obtained from Fish Lake and the remainder at different points on Yellowstone Lake. All eggs taken during the year were of excellent quality. The usual limited numbers were assigned to various State fish and game commissions, and smaller numbers were diverted for stocking the waters of the Glacier National Park. The remaining eggs were incubated at the lake hatchery, and fry to the number of 2,012,400 were distributed in Yellowstone Park waters, the park superintendent cooperating in the distribution.

GLACIER PARK (MONT.) SUBSTATION.

From the Glacier Park hatchery, which was in operation for a period extending from June 13 to September 17, 1921, there were distributed in park waters 2,035,000 fry and fingerling grayling, brook, rainbow, and blackspotted trout, with approximately 445,000 grayling and rainbow-trout fry on hand at the close of the fiscal year. The rainbow trout were derived from the Madison Valley egg collections and the blackspotted trout from the Yellowstone Park. For the grayling and the brook trout the bureau is indebted to the Montana Fish and Game Commission, and grateful acknowledgment of this cooperative assistance is hereby made. As in the Yellowstone Park distributions, officers of the national park service rendered valuable assistance in transporting the fish to suitable points for planting.

LEADVILLE (COLO.) STATION.

[CHARLES B. GRATER, Superintendent.]

The output of fry and fingerling fish from this station was smaller than usual because of certain conditions affecting the egg collections at two important sources. Low water at Turquoise Lake exposed the customary spawning beds of the trout, and attempts to take the fish by seines and fyke nets at other probable spawning points were not altogether successful. Similar conditions existed at Engelbrecht Lake, where further difficulties were experienced also in the matter of transportation. The aggregate total of brook-trout eggs obtained from the collecting fields occupied was 4,305,400. This station also handled 1,209,000 blackspotted-trout eggs transferred from the Yellowstone Park field, 130,000 rainbow-trout eggs from the stations in Wyoming and Utah, and 25,000 lake-trout eggs shipped from Michigan.

The Leadville station has for a number of years been able to successfully operate field stations at a number of privately owned lakes

and reservoirs, obtaining from them considerable numbers of brook-trout eggs for distribution in the form of fry and fingerling fish to applicants throughout Colorado and New Mexico and at the same time maintain unimpaired the original sources of supply. In recent years this work has suffered from the frequent labor changes occasioned by the low rate of compensation offered, and in certain instances the lake owners have refused to permit the continuance of fish-cultural work under the direction of the inexperienced men whom the bureau has been forced to place in charge. The time is at hand when a more definite policy with reference to this field of operations will have to be adopted if the work is not to seriously deteriorate.

SARATOGA (WYO.) STATION.

[O. N. BALDWIN, Superintendent.]

As has been mentioned in several previous reports, this field remains practically undeveloped because of lack of funds. Every year the station employees, at the expenditure of much time and labor, secure limited numbers of eggs at field stations where, with proper equipment and means for eying eggs intended for transfer and for the complete incubation of those needed for the maintenance of the local run of fish, the egg collections might be very greatly increased, the loss of eggs incident to their transfer in the green state obviated, operating expenses reduced, and the general efficiency of the work greatly improved. During the spring of 1921, with the primitive means available, the Sage Creek collecting field yielded 1,185,295 rainbow-trout eggs, Lost Creek, 982,185, and Canyon Creek—occupied for the first time—351,850, a total of 2,519,330. The station brood stock also produced 140,000 eyed eggs of this species.

Brook-trout eggs to the number of 1,132,400 were handled during the year. Of these 134,000 were taken from the station brood stock, 448,000 were received from Springville (Utah) station, and the remainder were taken at a new and promising field station located at Big Creek Lake, in North Park, Colo. This field is about 100 miles from the Saratoga station, well up on the Continental Divide. Incubation of the brook-trout eggs was completed a full month earlier than usual, with the result that most of the fry were taking food early in the winter.

Incidental to the other fish-cultural work, there are taken each season small numbers of Loch Leven-trout eggs, this species appearing to thrive in the streams of the region. With the more complete development of fields contiguous to the station it is probable that very successful work can be accomplished with the Loch Leven. Besides the species already mentioned, 200,000 blackspotted-trout eggs were received from Yellowstone Park collections and were incubated with a loss of only 6,000. The resulting fry and fingerlings entered into the general distribution. With improved roads and better transportation facilities there is reason to believe that the black-spotted trout will also eventually bear a conspicuous part in the operations of the Saratoga station. There remained on hand at the close of the year upward of 1,000,000 eggs, fry, and fingerling fish.

SPEARFISH (S. DAK.) STATION.

[D. C. BOOTH, Superintendent.]

There was a decrease in the output of this station during the fiscal year 1921 as compared with previous years, this condition resulting from the very limited water supply available. For a number of years the spring that has furnished the station with water has been decreasing in volume, until during the season of 1920 its flow did not exceed 25 gallons per minute. Quite opportunely, the city of Spearfish found it necessary to augment the city supply by constructing a new reservoir, and the bureau was able to effect an arrangement whereby it obtains the surplus water for its fish-cultural work. The expense involved in installing the new system made it necessary to greatly curtail all other expenditures during the year.

From the brood fish on hand 222,500 brook-trout eggs, 37,600 Loch Leven-trout eggs, and 79,000 rainbow-trout eggs were obtained. These collections were supplemented by the transfer of 150,000 rainbow-trout eggs from the Bozeman and Springville stations and 200,000 of that species from a commercial fish-culturist in Pennsylvania in exchange for an equal number of brook-trout eggs furnished from the bureau's Leadville station. Some 46,000 green brook-trout eggs were purchased from a local source, and 25,000 lake-trout eggs were received from the Duluth station. The fry and fingerlings resulting from all of this stock entered into the general distributions.

SPRINGVILLE (UTAH) STATION AND SUBSTATION.

[CLAUDIUS WALLICH, Superintendent.]

Fish-cultural work in this field during the year resulted in the distribution to applicants or in local waters from which egg collections were made of 463,600 No. 2 to No. 5 fingerling brook, black-spotted, and rainbow trouts, 250,000 eyed rainbow-trout eggs, 2,000 fingerling catfish, and 600,000 fry of the Bonneville whitefish from the Paris (Idaho) substation. In addition to the above approximately 700,000 fry and fingerlings of the various species of trout handled remained on hand at the close of the year and a total of 1,202,000 eyed brook-trout eggs were shipped, being consigned to the Bozeman, Saratoga, Spearfish, and Clackamas stations. These eggs do not enter into the records as an output of the Springville station.

Eggs to the number of 51,400 were obtained from the brood stock of brook trout at their first spawning. Because of inadequate facilities for handling the spawning fish there was a loss of eggs from natural spawning. The eggs taken were of a quality equal to that from wild fish. Spawning continued throughout the month of December. The brood stock of blackspotted trout yielded 107,800 eggs, the spawning season extending from March 20 to May 20. An overflow of muddy water through the pond system during the spawning season interfered with the most efficient conduct of the spawning work, hence the quality of the eggs was somewhat impaired. Spawning of the rainbow trout continued from December 30 to March 19, during which period 179,000 eggs were taken. In contrast to the brook trout the rainbows have continued in a healthy and

growing condition and successful results from the brood stock of that species are anticipated.

From the collecting stations located on Fish Lake, which are operating jointly by the bureau and the State of Utah, 1,901,400 brook-trout eggs and 1,734,800 rainbow-trout eggs were obtained as the bureau's share of the work. Employees of the bureau occupied the station at Twin Creeks from October 30 to November 14, after which the field was left to employees of the State. It is encouraging to note that the run of brook trout at this point has increased since the bureau's operations were undertaken, and it has been reported from reliable sources that a noticeable increase in the average size of the fish has occurred during the past two seasons, though this has not been verified by actual measurements or weight. The abundance of immature fish in the creek and along the shores of the lake appears to be a further indication of the success of the liberal planting of large-sized fingerlings.

During the course of the brook-trout egg collections it was noted that the adult rainbow trout were dying in considerable numbers, a condition that had existed for several months from information brought out on inquiry. The cause of the mortality could not be ascertained. The rainbow-trout spawning season at Twin Creeks occurred between May 1 and June 4, and at this time there was no indication of the mortality noticed in the previous fall.

There are several promising opportunities for extending the trout work of this station, among which may be mentioned the Kayune Reservoir, which is the property of the U. S. Fuel Co. This reservoir has been offered to the bureau exclusively for fish-cultural work, and the reports received from the plants of brook trout and rainbow trout made in it are most encouraging. There are very good prospects for early railroad communication with the Strawberry Reservoir, of the Reclamation Service, which is at present inaccessible during the spawning season of the rainbow trout. A recent investigation of Jorgensen Creek, a tributary of Fish Lake, about 4 miles from the present camp on Twin Creeks, indicates that a field station might profitably be established at that point. At the time the place was visited 46 large fish which had been beheaded by coyotes were noted.

The substation established for the propagation of the Bear Lake whitefish at Paris, Idaho, was opened on November 22 and operated until April 10. The usual difficulties encountered during the egg-collecting season—severe cold, violent winds, and snowstorms—prevailed without abatement. Eggs to the number of 1,056,000 were taken, from which 600,000 fry were hatched and planted, 500,000 being deposited on the spawning grounds in Bear Lake and 100,000 in Utah Lake.

COMBINATION TROUT AND POND FISH-CULTURAL STATIONS.

The stations possessing the greatest attractions for the general public are, perhaps, those located in sections of the country where the natural conditions make it possible to propagate both the Salmonidæ and the pond fishes. At such stations a brood stock of the

various species handled is maintained at all times and work of a strictly fish-cultural nature is under way throughout the year, whereas the fish-cultural work at certain of the hatcheries, especially those handling the commercial species, is seasonal in its character. The "combination" stations operated by the bureau are located at Erwin, Tenn.; Manchester, Iowa; Neosho, Mo.; White Sulphur Springs, W. Va.; and Wytheville, Va. Following is the aggregate output, by species, of this group of stations for 1921:

| | | | |
|--------------------------|-----------|---------------------------|-----------|
| Brook trout----- | 1,664,950 | Smallmouth black bass---- | 112,591 |
| Crappie----- | 14,332 | Sunfish----- | 62,355 |
| Largemouth black bass--- | 121,978 | Yellow perch----- | 58 |
| Pike perch----- | 500,000 | | |
| Rainbow trout----- | 2,583,244 | Total----- | 5,154,893 |
| Rock bass----- | 95,385 | | |

ERWIN (TENN.) STATION.

[A. G. KEESECKER, Superintendent.]

The aggregate output of this station shows an increase of about 30 per cent over that of the previous year. The spawning season of the rainbow trout began on November 8 and continued to January 27, the total egg collection amounting to 936,000, of which 822,000 were eyed. With the exception of 55,000 eyed eggs supplied to the State hatchery at Elkmont, Tenn., the entire lot was incubated in the Erwin hatchery. The losses were merely nominal, and the output of this species for the year amounted to 755,100, this number including 59,926 fingerlings derived from eggs transferred from the Neosho (Mo.) station. As an addition to the brood stock 10,000 steelhead eggs transferred from the Bird-view (Wash.) station were incubated, producing 9,300 fry. The year's work with the rainbow trout indicates a very satisfactory improvement, both with regard to the productivity of the brood fish and the quality of the eggs secured. No brood stock of brook trout is maintained at this station, all eggs of that species handled being acquired by purchase from commercial dealers. During the year the 439,300 eggs thus acquired resulted in an output of 300,435 fingerlings.

The spawning season of the smallmouth black bass began on April 13 and continued to May 28. Twelve nests were occupied, and 10 of them were productive, though the percentage of fry hatched in each nest was small. The distribution of this species amounted to 5,165 fingerlings, and it was estimated that upward of 3,000 were on hand at the close of the year. The outcome of the operations with the largemouth black bass was better, 65,980 of these being available for distribution, with approximately 10,000 on hand at the end of June. During the spawning period, extending from April 13 to June 1, the warm weather during the spring was followed by colder weather, and this was an important factor in reducing the output of both species of black bass. The year's distribution also included 17,200 rock bass, 400 strawberry bass, and 20,350 sunfish, all fingerlings.

MANCHESTER (IOWA) STATION.

[FRANK E. HARE, Superintendent.]

The output of this station consists of 125,500 eyed eggs of the rainbow trout and 678,585 fry and fingerling fish of the different species propagated. The rainbow-trout brood stock did not yield an altogether satisfactory return, there being only 378,600 eggs taken. With the maturity of plans now being formulated a very decided improvement in this direction is confidently expected. During the spring 25,000 eggs taken from wild rainbow trout were transferred to Manchester from the bureau's Montana station with the view of infusing new blood in the brood stock, and the product of an equal number of steelhead eggs shipped from the Birdview (Wash.) station will also be reared with that end in view. The adult brook trout, consisting of 625 2-year-old fish and 35 fish 3 years old and over, yielded 58,000 eggs. These fish were again affected by a gill disease just prior to the spawning season and suffered a heavy mortality. Brook-trout eggs to the number of 550,000 were obtained from commercial dealers in Massachusetts and incubated with satisfactory results. The cold weather of the late spring reduced the output of largemouth black bass to 2,500 fingerlings, but better success attended the culture of the rock bass, the distribution of that species amounting to 53,910 No. 1½ fingerlings.

NEOSHO (MO.) STATION.

[FRED J. FOSTER, Superintendent.]

There was a very satisfactory increase in the output of rainbow trout from this station for the fiscal year 1921. The records indicate that the egg shipments were increased over those of the preceding year by 48 per cent, while the increase in the number of fingerling fish distributed was as high as 117 per cent. The improvement was not confined solely to the increased number of fish and eggs produced but has been extended to the quality of the product and a betterment of the condition of the brood stock.

For a number of years the station has been supplied with water from two sources—the Hearell Spring and the McMahon Reservoir. Observations made by the superintendent led to the belief that the eggs of fish held in ponds supplied from the spring were not equal, either in numbers or quality, to those taken from fish in ponds supplied from the reservoir. For the purpose of testing the soundness of this theory the following experiment was conducted: A number of 3-year-old rainbow trout from the same hatch, which up to the time of the experiment had been held in the same pond, were divided into two equal lots. One lot was placed in pond No. 18, supplied entirely with water from the McMahon Reservoir, and the other was placed in Pond F, supplied largely from Hearell Spring. The eggs obtained from fish held in the McMahon water proved 82 per cent

fertile, while the rate of fertility of the other lot was only 67. This and further experiments along the same lines gave these results:

| Pond. | McMahon water. | Hearell water. | Fertile eggs. | Pond. | McMahon water. | Hearell water. | Fertile eggs. |
|-------------|------------------|------------------|------------------|------------|------------------|------------------|------------------|
| | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> | | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
| No. 18..... | 100 | 0 | 82 | No. 5..... | 50 | 50 | 77 |
| No. 15..... | 70 | 30 | 80 | No. F..... | 30 | 70 | 67 |

It is unfortunate that more complete data on these experiments are not available, and perhaps the data at hand can not be accepted as conclusive. Nevertheless, the evidence seemed sufficiently strong to warrant the construction of two new ponds supplied entirely with the McMahon water and the alteration of present lines to admit of a further elimination of the Hearell water from the stock ponds. During the coming year the brood stock of rainbow trout will be held exclusively in ponds supplied with the McMahon water. The nature of the apparent ill effects of the water from Hearell Spring on the adult fish has never been ascertained, but an ovarian affection appears to prevail among the fish that have been retained in that water for any considerable period.

Another item of possible interest in trout culture at the Neosho station was the occurrence of a disease among the fingerling trout, both at the main station and at the Roaring River substation, resulting in some loss. The trouble first appeared as a discoloration of the gills from cream to brown in color, sometimes one and sometimes both gills being affected. This was followed by an apparent disintegration of the tissues and finally by a peculiar sloughing off of the gill. The trouble manifested itself only in the newly constructed ponds or in ponds supplied with water from recently constructed reservoirs. On being removed to surroundings entirely remote from new concrete work the fish recovered rapidly, even in advanced cases where the gill seemed to have been destroyed. After being treated with a 1 to 1,000 solution of copper sulphate these affected ponds were allowed to remain idle for several months, and no trouble in connection with their use has since developed.

The output of pond fishes also shows an improvement over the recent past, the aggregate having been exceeded only in two previous seasons. Further improvement in this line of effort involves some interesting problems. The ovarian trouble of the rainbow trout may be present among the pond fishes held in water from Hearell Spring, and investigations looking toward the solution of this phase of the subject are already under way. The station ponds devoted to the production of the warm-water species are well supplied with natural food for their young, and were fingerling fish produced to the extent of the natural food available the station's output would be materially increased. The warm-water species propagated are largemouth and smallmouth black basses, rock bass, sunfish, crappie, and yellow perch. Artificial nests were tried in connection with the spawning of the largemouth black bass, with results that led the superintendent to recommend their general use. The output of the station by species is indicated in the tabular statement showing the production of fish by stations on page 12.

WHITE SULPHUR SPRINGS (W. VA.) STATION.

[DELL BROWN, Superintendent.]

Work at this station during the year was conducted along the usual lines. The results from trout propagation, both the brook and the rainbow, were of a satisfactory nature, but, on the other hand, the spawning of the two species of the pond fishes turned out to be an almost total failure.

The brood stock of approximately 2,700 female rainbow trout 2 years old and older produced 1,058,900 eggs, or more than a half million in excess of the previous season's collection. Only 68 per cent of them hatched, however, and the cause of this heavy mortality can not be explained. On reaching the eyed stage 447,000 were supplied to applicants and transferred to other stations of the bureau. The remainder were incubated at the station, together with a consignment of 100,000 received from the Wytheville (Va.) hatchery. The brood stock of brook trout, consisting of about 150 3-year-old fish and 350 2-year-old fish, yielded 80,000 eggs, which number was supplemented by the purchase of a million eggs from commercial dealers in New England. The so-called "white-spot" disease caused some mortality among the fry of this species just prior to the feeding stage, and a gill affliction was prevalent later among the fingerlings. Eggs to the number of 22,000 were taken from 150 3-year-old albino brook trout. The males of this lot appeared to be lacking in virility, and some difficulty was experienced in obtaining the necessary fertilizing medium. Nine thousand fingerlings resulted from these albino eggs, 1,000 of which were furnished to applicants, leaving 8,000 on hand at the close of the year.

A consignment of adult smallmouth black bass obtained from Lake Erie waters for a brood stock survived the winter without undue loss, numbering 115 at spawning time. During the spring 46 nests of this species were noted in the ponds, and the output of fry amounted to 100,500. The 23 largemouth black bass on hand produced 25,800 fry and 600 fingerling fish. The results from the rock bass and sunfish were negligible. This condition was attributed in part to lack of proper nourishment, it having never been the custom to feed the brood-pond fishes at this station. Steps have now been taken to feed them on beef heart, and the results will be carefully noted.

WYTHEVILLE (VA.) STATION.

[GEORGE A. SEAGLE, Superintendent.]

During the spawning season of the rainbow trout the 2,960 adult females on hand yielded 870,352 eggs, of which shipments totaling 480,000 were transferred in the eyed state to applicants and to other hatcheries of the bureau. The spawning season was unusually protracted, extending from October 10, 1920, to March 15, 1921, the wild fish recently introduced into the brood stock probably being the later spawners.

At the beginning of the spawning season 695 2-year-old fish were turned over to a representative of the scientific division for experiment. From these fish 30,500 eyed eggs and 19,000 fry were returned to the hatchery stock at the end of the season's investigations, and

they are included in the station's output. The experimental work connected with the spawning of the rainbow trout will be continued over a series of years, the operations next year to be conducted at Erwin, Tenn. With this end in view 416 of the adult fish involved in last season's work have been transferred to Erwin.

The output of brook trout from the station was reduced to negligible proportions by an apparently infectious disease which attacked the fry shortly after incubation was completed. Eggs from commercial hatcheries to the number of 274,000 were received, but because of this trouble only 30,900 fry were available for distribution. The output of this species also included 1,900 No. 4 fingerlings carried over from last year's hatch.

The largemouth black bass, usually prolific at this station, produced very few young. The brood stock consisted of 194 fish, and during April 60 nests were counted in one pond. A sudden drop in temperature had the effect of destroying all the eggs deposited, and the few fry produced were the result of a later spawning. The distribution of rock bass consisted of 14,060 fingerling fish Nos. 2 and 3 produced from 230 brood fish, while 10,325 sunfish comprised the output from a stock of 200 breeders of that species. Adult crappie to the number of 47 were carried through the year, but so far as could be ascertained the fish did not spawn, nor have they been known to take food. Of the 20 catfish transferred from the Cold Springs (Ga.) station last year only 5 remained at the end of June, 1921. Because of the rather dense growth of vegetation in the pond in which they were carried nothing could be learned as to any possible spawning activities. A consignment of 500,000 pike-perch eggs received from the Swanton (Vt.) hatchery was successfully incubated, and the resulting fry were planted in New River, Va.

With the view of increasing the efficiency of the work at the Wytheville station, particularly in connection with trout propagation, further repairs and improvements were made in addition to the new water-supply system installed last year. The more important features of this improvement were the demolition of the old wooden building used as a nursery and the construction of a new two-story building 56 by 36 feet. The building is of concrete to the window sills of the second story and of frame construction above that. It will contain 60 standard troughs—20 on the first floor supplied with brook water and 40 on the second level—which may use either brook or spring water, or a mixture of both as may be desirable. An enlarged settling tank and filter are also in process of construction for the correction of the turbid condition to which the spring water is subject for long intervals after heavy rains.

WORK OF POND FISH-CULTURAL STATIONS.

Climatic conditions play an important part in all branches of fish culture, but the success or failure of a season's work at a pond-cultural station is peculiarly susceptible to temperature changes in the spring. If the weather in the early spring is warm, the spawning activities of the fish, particularly the basses, are hastened. Should this condition be followed by a period of falling temperatures, it inevitably results in the desertion of the nests by the adult fish and the loss of practically all the eggs produced.

Future work looking to an increase in the output of the pond fishes must lie along the line of more intensive cultural methods. The proper steps to be taken in this direction are as yet more or less of an unsolved problem, but such studies as have been made would indicate that the problems are subject to satisfactory and practical solution. To the practical fish-culturist the deductions formed by observation of the results obtained from a certain pond giving most excellent results are sometimes seemingly contradicted by the results from another pond where conditions, from the generally accepted theories, are more favorable. Further investigations and studies of these interesting and important problems are urged as being absolutely essential.

Another point in connection with the operation of the pond stations is to determine the most suitable and effective way to distribute the output. The very young fry can not be successfully handled. Even the transfer of such fry to rearing ponds usually meets with a very heavy mortality. On the other hand, if they are retained in the spawning ponds with the adults the first fry appearing are sure to prey to a large extent on the progeny of the later spawners and will themselves fall a prey to the adults. The loss of young fish from cannibalism is large in an artificial pond under the best of conditions. Perhaps the most suitable time to effect the transfer to rearing ponds or to distribute the fish in them is in the advanced fry or No. 1 fingerling stage. At this time they are hardy enough to withstand careful handling, and, being still under the guardianship of the male parent, may easily be taken in a net as they school along the shores of the pond.

SUMMARY OF OUTPUT.

The output of the stations devoted to the culture of the so-called warm-water or pond fishes during the fiscal year 1921 aggregated 2,473,711, as opposed to a production of 1,837,598 the preceding year. The seven stations included in the pond fish-cultural group are given in the table below, with the figures of the aggregate output of each for the fiscal years 1920 and 1921. The Edenton (N. C.) station, though listed with the pond fish-cultural stations, also does important work with the shad and glut herring, mention of which is made on pages 42 and 44 in this report.

OUTPUT OF POND FISH-CULTURAL STATIONS, FISCAL YEARS 1920 AND 1921.

| Station. | Output. | | Station. | Output. | |
|--------------------------|---------|-----------|----------------------|-----------|-----------|
| | 1920 | 1921 | | 1920 | 1921 |
| Cold Springs, Ga..... | 226,833 | 279,675 | San Marcos, Tex..... | 376,500 | 408,811 |
| Edenton, N. C..... | 42,560 | 32,990 | Tupelo, Miss..... | 472,420 | 479,875 |
| Louisville, Ky..... | 404,475 | 1,020,450 | Total..... | 1,837,598 | 2,473,711 |
| Mammoth Spring, Ark..... | 39,895 | 32,325 | | | |
| Orangeburg, S. C..... | 274,915 | 219,675 | | | |

COLD SPRINGS (GA.) STATION.

[CHARLES W. BULLOCK, Superintendent.]

Five spawning and two rearing ponds were completed during the year at this station, and it was hoped the additional facilities provided would permit of a material increase in output. As at other points in the Southern States, the weather during the bass spawning season was not propitious. There was a heavy spawning during an unusually warm period in March, permitting of the shipment of more than 100,000 advanced fry in April, whereas the distribution does not usually begin before May 1. A sudden cold spell in April caused a drop of 20 degrees in the water temperature. This resulted in destroying what had appeared to be bright prospects for a remarkably successful season. During the cold weather many of the schools disappeared, and the fish hatched later were small and their rate of growth slow. The few stragglers surviving from the schools destroyed preyed freely on the weaker fish. Perhaps not of the least importance in contributing to the disappointing results was the almost total disappearance from the ponds of the cladocerans, copepods, and chironomids that had been observed in abundance during the early spring. While the numbers of bass produced for distribution represent a very fair average for the station, in view of the promising outlook in the early spring the results are disappointing.

At the Harris Ponds substation catfish and bluegills are reared in the same ponds. In certain respects the bluegills can be more satisfactorily handled than the bass, as they take readily to artificial feeding. It is never possible to anticipate results in the propagation of catfish. In certain seasons the output will be ample for all needs, while the next season, under apparently identical conditions, only small numbers of young are produced. During the past season only 5,000 fingerlings were obtained from 60 adults. In the course of the spring one of the ponds were stocked with 50 adult catfish in addition to the bluegills. Later in the season a heavy mortality occurred as a result of a parasitic affection.

Attempts to propagate crappie at this station have not been particularly successful. Two ponds devoted to the species produced 1,750 fingerlings. Two hundred of these were reserved for brood fish, but as they are very shy and nervous, refusing to take artificial food, it is doubted if they will be of much value in that connection.

The station water supply is lacking in lime or other mineral substance, excepting for a trace of silica. The presence of lime in solution has always been considered desirable in pond fish culture. By way of experiment the water supply to one of the ponds was arranged to pass over a cask of lime, and the results are being noted.

The output of the station for the fiscal year consisted of 212,555 largemouth black bass, 4,120 catfish, 1,550 crappie, 61,350 sunfish, and 100 warmouth bass. Approximately 145,000 of the bass were fry, while the others were all of the fingerling size.

EDENTON (N. C.) STATION.

[EDW. M. HAYNES, Superintendent.]

Five ponds at this station are devoted to the production of the pond fishes, and their output for the year consisted of 23,085 large-

mouth black bass and 9,904 sunfish, all of the fingerling 2½ size. Thirty adult crappie, obtained during the season for use as brood fish, failed to reproduce, the fluctuating air and water temperatures during the spawning season having a decidedly unfavorable influence on these fish, as it also did on the bass. No recent changes have occurred in the method of conducting the work at this point.

LOUISVILLE (KY.) STATION.

[CHARLES W. BURNHAM, Superintendent.]

The fiscal year 1921 marks the most successful season in the history of the station in the production of fish. The output aggregated 1,020,450 fry and fingerlings, divided, by species, as follows: Largemouth black bass, 33,100; rock bass, 4,500; smallmouth black bass, 156,700; sunfish, 76,150; and yellow perch, 750,000. These fish were distributed to applicants in Kentucky, Indiana, and Ohio, and liberal plants of sunfish were made in local waters.

The brood stock of smallmouth black bass was increased during the year by the purchase of 277 adults from Lake Erie fishermen. Of this number 52 died shortly after being received. The remainder were placed in a spawning pond, but failed entirely to spawn. It is difficult to assign a reason for this, as the fish appeared to be in a healthy condition throughout. A number of those that died from the effects of transportation were examined and found to be carrying eggs, and the 125 older fish at the station produced very excellent results under similar conditions.

It is perhaps worthy of mention here that of the 200 adult smallmouth black bass sent to the Mammoth Spring (Ark.) station from Lake Erie none survived the winter. In connection with the propagation of the basses, it is interesting to note that the young smallmouth black bass grow much more rapidly than the young of the largemouth black species.

Yellow-perch propagation at Louisville was successful this season, the 750,000 fry distributed being the progeny of 300 brood fish. It may be possible to considerably extend this branch of the work by increasing the number of breeders carried in the ponds.

MAMMOTH SPRING (ARK.) STATION.

[WILLIAM S. VINCENT, Superintendent.]

A considerable amount of work looking to the improvement of the pond system was accomplished at this station during the year. Such work in the main has consisted in the installation of concrete "kettles" and outlets in many of the ponds, comprising what is believed to be an innovation in pond construction. (See Fig. 3, opp. p. 68.) Improvements were also made in the drainage system. Four small rearing ponds were converted into one large one, and work was done for the improvement and increased fertility of the bottoms of the ponds.

In an effort to build up the brood stock a number of adult fish of the various species propagated were obtained from local waters during the late summer and early fall. In October 200 adult smallmouth black bass were transferred from Lake Erie. Most of these were unable to survive the winter, and all had perished prior to the

spawning season. Hence, the total number of brood fish of this species on hand at that period did not exceed 200. The smallmouth black bass were first observed to be spawning on March 28, when 12 nests were noted, and 38 nests had been occupied by April 8. By the end of the third day fungus had entirely destroyed the eggs on the first 12 nests, and only a negligible number of fry was produced from the remainder of the first spawning. Spawning was resumed on May 6 and 7, when 12 more nests were occupied. From this spawning the total output of smallmouth black bass, amounting to 26,500 fry and fingerling fish, was obtained. No satisfactory explanation for the failure of the early spawning is at hand. The long interval between the spawning periods observed this season is unusual. In previous years it has rarely exceeded one week. In addition to the smallmouth black bass, smaller numbers of the largemouth black bass and rock bass were distributed.

ORANGEBURG (S. C.) STATION.

[GEORGE W. N. BROWN, Superintendent.]

At this station a new pond, approximately 1 acre in area and supplied with water from springs at the head of the small cove in which it is built, was completed and stocked with bass. The output consisted of 204,675 largemouth black bass, 300 crappie, 500 rock bass, and 14,200 sunfish (bluegills), all of fingerling size. A small number of sunfish carried over from the previous year were distributed in connection with the current season's hatch. The station has also a small stock of the spotted catfish (*Ictalurus punctatus*), and it was estimated that approximately 1,000 young of the species were on hand at the close of the year.

SAN MARCOS (TEX.) STATION.

[MARK RILEY, Superintendent.]

The distributions from this station for the year 1921 included the following species: Largemouth black bass, 257,715; catfish, 70,000; crappie, 5,904; rock bass, 320; sunfish, 74,872. The San Marcos station has for a number of years been successful in producing goodly numbers of fish for distribution at a cost that compares favorably with that at any other station. Local conditions seem particularly suited to the purpose, and, unlike the conditions at all other stations, it is not necessary to supply artificial food for either the young or the adult fish. The output for the year 1921 was curtailed by fluctuating water temperatures during the spring and, further, by the ponds overflowing on two occasions, an occurrence that is caused by the unsatisfactory method of street drainage. To augment the production of fish beyond the capacity of the station ponds it has been customary to stock privately owned ponds or "tanks" with fish, with the understanding that the bureau shall have the privilege of taking a reasonable number of the progeny for distribution. Very satisfactory results have been obtained by this method, particularly with the crappie.

TUPELO (MISS.) STATION.

[DAVID DAVIES, Superintendent.]

The output of this station for the year consisted of 405,500 largemouth black bass, 73,005 sunfish, and 1,280 crappie, and the distribution was extended to approximately 310 applicants, located in Mississippi, Alabama, Tennessee, Arkansas, Louisiana, and Kentucky. The station output was also supplemented by a carload shipment of miscellaneous fishes from the rescue field on the upper Mississippi River, consisting of crappie, catfish, rock bass, buffalofish, carp, and yellow perch, all of which entered into the general distributions.

Of possible interest in connection with pond fish culture was the unusually late spawning of the largemouth black bass this year. On August 19, 1921, a lot of 3,000 advanced largemouth black-bass fry were taken from one of the station ponds, and again, on September 28, another lot of the same species and size was obtained.

PRACTICAL DEVICES FOR USE IN POND FISH CULTURE.

A PRACTICAL SYSTEM OF CLEANING FISHPONDS.

The necessity for the frequent cleaning of ponds in which fish are retained under artificial conditions is well known. If the ponds are of cement or lumber construction, the usual method of cleaning is to lower the water level and scrub the sides and bottom of the pond with a suitable brush. During the cleaning process the water in the pond becomes turbid and polluted from stirring up the accumulated sediment and filth from the bottom of the pond. The fish are forced to endure this unnatural condition until the pond is scrubbed, the accumulation of sediment flushed out through the outlet, and the pond again filled with clear water. In addition to this unfavorable condition to which the fish are exposed they are subject to further possible injury by bruises from contact with the brushes used in the scrubbing process. These conditions are entirely unavoidable under the system of cleaning in general use.

At the Manchester (Iowa) station a system of cleaning ponds that successfully overcomes both these difficulties has been adopted. (See Fig. 2.) At this station there are eight stock ponds of cement construction. They are approximately 80 by 13 feet and are 3 feet deep at the outlet, the bottom sloping upward toward the inlet, where the depth is $2\frac{1}{2}$ feet.

For the proper cleaning of the ponds a cement wall or dam, extending into the pond $4\frac{1}{2}$ feet from each side, is installed, leaving a 4-foot opening in the middle. This dam is placed 20 feet from the inlet end of the pond and is 1 foot high. The open ends are grooved to accommodate a dam board 2 inches in thickness. In cleaning the pond the water level is lowered until that portion of the pond bottom between the inlet and the division wall is just covered. The pond being deeper at the outlet end, there is still sufficient water to hold the fish safely while the other section of the pond is being cleaned and flushed. After cleaning the first section the water is permitted to rise until the division wall is about submerged. The fish are then driven through the 4-foot opening in the wall into the clean section of the pond by the use of a "push screen." A board

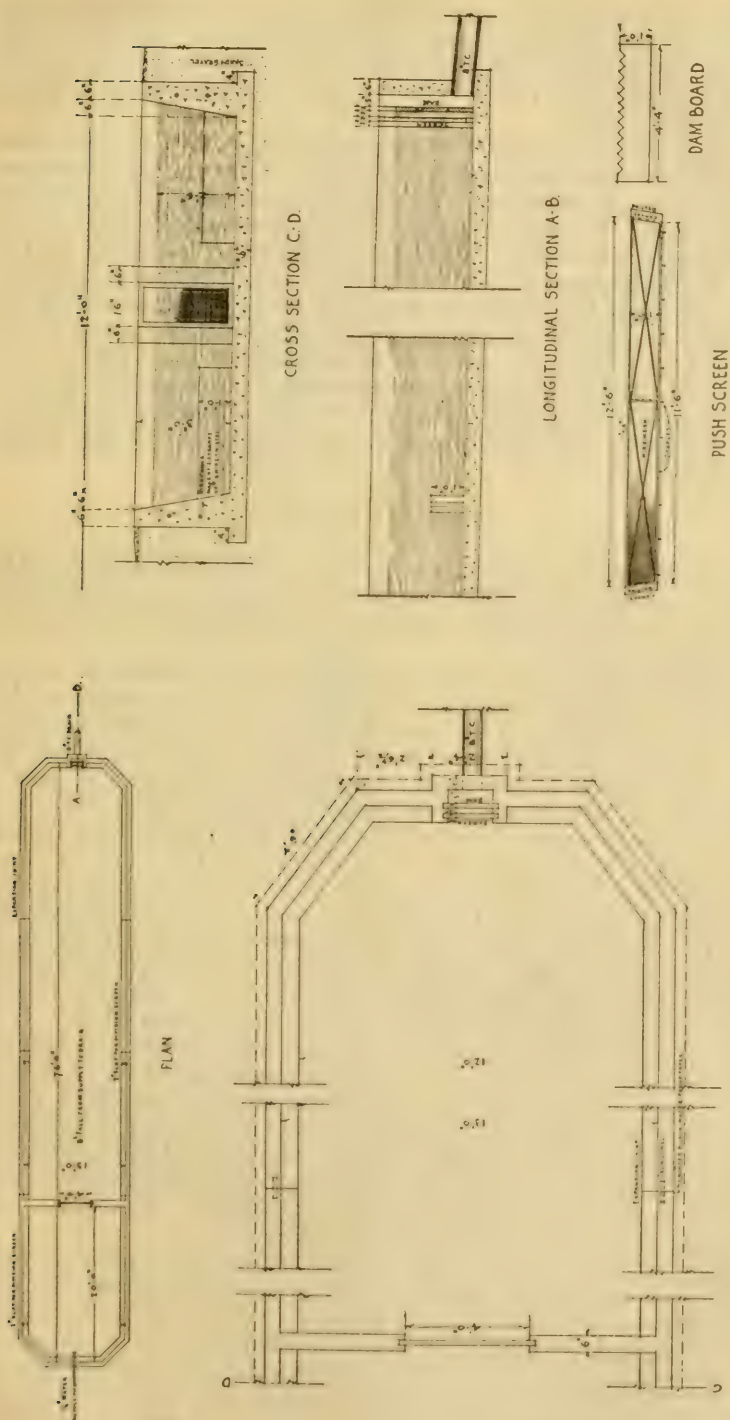


FIG. 2.—Plan of dam and "push screen" for convenient cleaning of stock fishponds. (Designed by F. E. Hare.)

2 inches thick, 1 foot wide, and 4 feet long is inserted in the grooves in the ends of the division wall to retain the fish, while the remaining portion of the pond is being cleaned. The dam board has a saw tooth edge permitting the overflow water to pass but preventing the escape of the fish.

The "push screen" consists of a frame made of 1 by 4 inch lumber, to which is attached poultry netting of 1-inch mesh or smaller if the size of the fish requires. The smaller dimension of the lumber forms the face of the screen, to offer but slight resistance when being pushed through the water. Its shape conforms to the shape of the ponds. At Manchester the sides flare outward. In size it is somewhat shorter than the width of the pond for convenient handling, and to prevent the escape of fish around the ends strips of heavy duck or canvas belting are attached to each end of the screen. Iron staples driven into the bottom board at suitable intervals and slightly protruding will serve to keep the board from dragging on the bottom of the pond and facilitate the easy movement of the screen through the pond.

POND OUTLET AND "KETTLE."

As being of possible interest and value to persons interested in the subject a drawing of the pond outlet and "kettle" previously mentioned (p. 64), with descriptive text and specifications for construction, are given (Fig. 3).

In referring to the cut of the pond outlet and "kettle" it will be noted that it contains features not embodied in other constructions of a similar character. The drain box is made in about the same manner as those now in use at many stations, but in place of the wooden dam boards it has a cement dam *B*, the height of which is determined by the water level when the pond is filled. If it is desired to raise the water level of the pond, the wooden dam boards can be dropped in the slot *C*. The screen *D* is the same as those now in use. To draw down the water in the pond, a gate valve *A* is so placed at the bottom that all of it can be drawn through the kettle. To make this removable, a flanged valve of the standard low-pressure type is used. A short nipple with a flange on one end is placed in the forms when making the drain box. Later a rubber gasket is cut to size and the gate valve is bolted into place. It is not necessary to bolt the valve around the bottom, since it may be desirable at some time to remove it, and it would be a difficult matter to get at bolts so located. A 6-inch gate valve as described above measures approximately 10½ inches from face to face of flanges. Therefore, a standard valve should be used in place of the medium or heavy service valves. It will be necessary to place the flange of the nipple as close to the cement dam *B* as possible. Therefore, the bolts should be put in place before cementing.

Another feature of the plan is the construction of a cement "kettle" in front of the drain box. It will be noted that the side walls of this kettle extend approximately 12 inches above the earth floor of the pond, so that in drawing down the water in the pond when it drops below this point it must then enter at the sluice gates *E*. The small fish will be drawn down through these gates and will immediately seek the more quiet water at the upper end of the kettle.

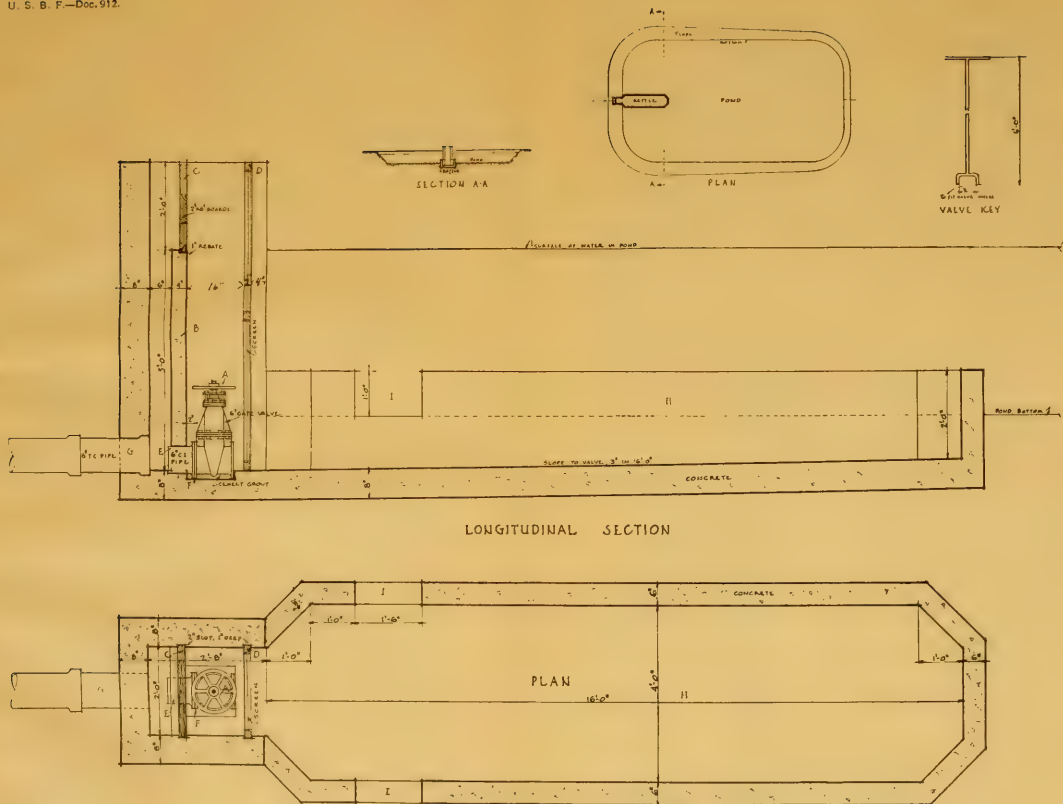


FIG. 3.—Plan of pond outlet and kettle for fishponds. (Designed by G. C. Leach.)

The water in this portion of the kettle is more or less clear. If only a few fish are desired, they can sometimes be dipped out with the ordinary hand dip net. In some instances it has been found advisable to put a cement walk around the outside of the kettle. This enables the fish-culturist to dip the fish out with greater ease and without agitating the mud on the earth bottom of the pond.

When it is desired to draw the water entirely off the pond, it is first lowered to about one-half its depth and the mud on the bottom of the kettle is stirred with a long-handled spade or broom until it is well agitated, when the gate valve *A* is opened wide and it is flushed out. After this the pond may be drawn down slowly and the fish drawn into the kettle. When the earth bottom of the pond is bare, there will be 1 foot of water in the kettle.

A 6-inch gate valve is sufficiently large for a pond one-half acre or less in area, an 8-inch valve for a three-fourths acre pond, and a 10-inch valve for a 1-acre pond.

SPECIFICATIONS.

Gate valve *A* is flanged and bolted to companion flanges *F* on nipple *E*, which passes through the center of cement dam *B*. The height of dam *B* is to correspond with the desired water level in the pond. Should it be necessary to raise the water level, wooden dam boards may be dropped in the slot *C*. *D* is the screen made in one or two sections, with a mesh in accordance with the size of fish to be carried. The gate valve should be set low enough for the water to drain out of the kettle *H*. Kettle *H* is constructed with end and side walls 12 inches higher than the earth bottom of the pond.

Preparatory to drawing down the pond for the removal of the fish the water is lowered by opening the gate valve with extension rod *J* to a point where it is possible to clean the bottom of the kettle with a long-handled brush. The mud and roily water is flushed out by opening the gate valve wide.

In drawing down the pond after the water level drops below the top wall of the kettle all water from the pond must enter at the side sluices *I*. This leaves the water comparatively quiet in the upper end of the kettle. The small fish seek that portion of the kettle and may easily be removed with a hand dip net.

Material in drain box.

Sides 8 inches, bottom 6 inches; total amount concrete, 50 cubic feet.

| | | | |
|------------------|------------|------|---|
| Cement | bags | 12 | 1-2-4 mixture. Sand and broken stone or screened gravel. |
| Sand | cubic feet | 22.5 | |
| Stone and gravel | do | 45 | |

Sides 6 inches, bottom 6 inches; total amount concrete, 38 cubic feet.

| | | | |
|-----------------|------------|----|----------------|
| Cement | bags | 9 | 1-2-4 mixture. |
| Sand | cubic feet | 17 | |
| Stone or gravel | do | 34 | |

Fittings for drain box.

6-inch standard flanged gate valve.
6-inch companion flange.
6-inch nipple 6 inches long,

Reinforcement for dam.

Galvanized stock fence wire, 24-inch width preferred.

Material for kettle.

Walls 6 inches, bottom 6 inches; total amount concrete, 80 cubic feet.

| | | | |
|----------------------|--------------|----|----------------|
| Cement----- | bags-- | 20 | \| 1-2-4 mixture. |
| Sand----- | cubic feet-- | 38 | |
| Stone or gravel----- | do----- | 75 | |

MODIFIED FORM OF POND OUTLET.

Figure 4 on page 71 shows a modified form of the outlet just described, Figure 3.

In this outlet terra-cotta pipe has been substituted for iron, and the bell end of the terra-cotta ell, closed by the wooden disk, replaces the gate valve, while the cement dam, screen, removable wooden dam boards, and other features remain the same. When the pond is full, the ell opening is closed by the wooden disk, made tight by the use of clay. The wooden dam boards need not be used unless it is desired to raise the water level above the height of the permanent cement dam. To drain the pond, the wooden dam boards are fitted into their proper place and the wooden disk closing the ell opening in the terra-cotta dam pipe is removed by means of the iron rod to which it is attached. The depth of water at any stage of the operation may be controlled by proper manipulation of the wooden dam boards.

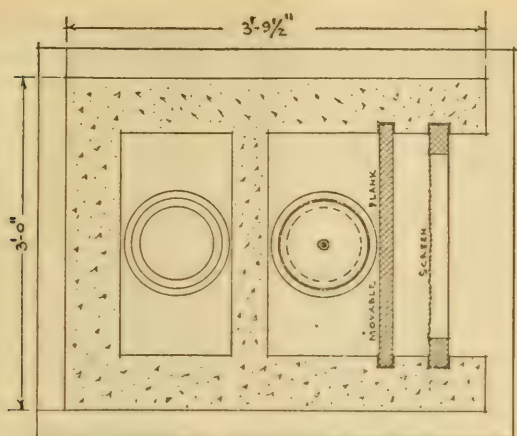
Each of the outlets described here, as well as the one described in a previous publication of the bureau,³ has distinctive points of advantage and have been developed in meeting the varied conditions encountered in fishpond construction. It remains for the prospective pond builder to select the type best suited to his needs. The types described here are considered particularly desirable in ponds of comparatively large area or where the amount of water to be carried requires the use of correspondingly large pipe. The convenience of the valve in controlling the flow of water in drawing the pond, Figure 3, is easily recognized, but practically the same results are obtainable with the simpler installation shown in Figure 4, and the cost of fittings for this type will be somewhat less.

Work of Central Station, Washington, D. C.

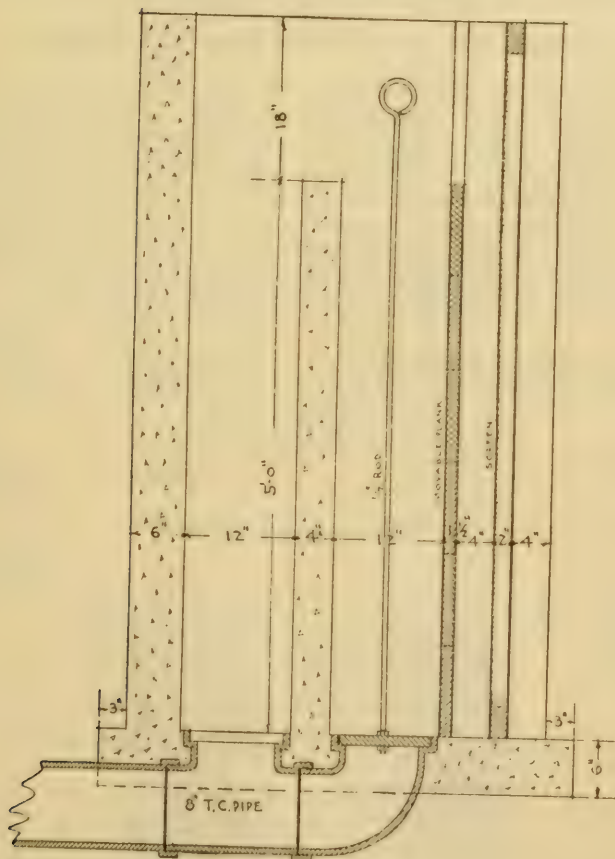
[L. G. HARRON, Superintendent.]

Beginning with rainbow-trout eggs in December, 1920, and closing with pike-perch eggs in May, 1921, there were incubated in the hatchery apparatus maintained in the fisheries building at Washington for public display 7,717,000 fish eggs, representing eight species of fish—chinook salmon, rainbow and brook trouts, whitefish, cisco yellow perch, pike perch, and shad—from which 6,400,327 fry and fingerlings were distributed to applicants in Maryland, Virginia, West Virginia, Delaware, Pennsylvania, and New York.

³ Coker, R. E.: Progress in Biological Inquiries, 1921. Report of the Division of Scientific Inquiry for the Fiscal Year 1921. Appendix VIII, Report, U. S. Commissioner of Fisheries for 1921, 38 pp., 2 figs. (A new Form of Pond Outlet, pp. 21-24, Figs. 1 and 2.) Washington, 1922.



PLAN



SECTION

FIG. 4.—Plan of a simple and inexpensive outlet for fishponds.
(Designed by G. C. Leach.)

In addition to the hatchery exhibit a display of adult fresh-water fishes was maintained in the aquaria throughout the year. The total number of fish exhibited was 2,614, representing 45 species. Collections for restocking were made from time to time from the Potomac River at Bryans Point, Md. Other sources of supply were the bureau's stations at White Sulphur Springs, W. Va.; Bellevue, Iowa; Bozeman, Mont.; the New York Aquarium, and the New York Conservation Commission hatchery at Caledonia, N. Y.

The health of the aquaria fishes throughout the year was generally good, with the exception of a short period during May and June, when a number of the fish were attacked by the parasite *Ichthyophthirius*, causing a considerable loss, particularly among the warm-water fishes. It has recently been found that this parasite may be destroyed by treating the fishes infected with a saturated solution of bicarbonate of soda. The solution is conveniently applied directly to the fish when held in shallow water with a small paintbrush. The treatment removes the mucous coating from the fish and destroys the parasite with no injury to the fish.

Spawning Seasons of Fishes Handled at Stations.

Records of the spawning seasons of the various species of fishes handled at the bureau's stations during the fiscal year 1921, together with the water temperatures at the beginning and end of such periods, are given in the following table, in which the stations are grouped and arranged as in the preceding discussion of the propagations of the commercial species and the species for stocking the interior waters; that is, Pacific salmon, Great Lakes, Marine, New England salmon and trout, Rocky Mountain trout, combination trout and pond fish-cultural, and pond fish-cultural stations.

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, WITH WATER TEMPERATURES AT BEGINNING AND END OF PERIODS, FISCAL YEAR 1921.

PACIFIC SALMON STATIONS.

| Station. | Species. | Spawning season. | Water temperatures, °F. | |
|-----------------------|-------------------------|--------------------------|-------------------------|----------------|
| | | | Beginning of season. | End of season. |
| Afognak, Alaska..... | Sockeye salmon..... | July 31 to Sept. 24..... | 52 | 40 |
| Baker Lake, Wash..... | Silver salmon..... | Nov. 17 to Dec. 15..... | 40.5 | 35.5 |
| | Sockeye salmon..... | Oct. 10 to Nov. 30..... | 46 | 39 |
| | Chinook salmon..... | Sept. 20 to Oct. 25..... | 43 | 41 |
| Birdsview..... | Silver salmon..... | Nov. 20 to Feb. 11..... | 43 | 41 |
| | Steelhead salmon..... | Mar. 26 to May 21..... | 44 | 47 |
| | Chum salmon..... | Nov. 15 to Jan. 6..... | 50 | 48 |
| Brinnon..... | Steelhead salmon..... | Apr. 15 to May 11..... | 42 | 52 |
| Duckabush..... | Chum salmon..... | Aug. 28 to Sept. 12..... | 49 | 49 |
| | Silver salmon..... | Nov. 27 to Mar. 1..... | 46 | 44 |
| | Steelhead salmon..... | Apr. 11 to May 27..... | 46 | 48 |
| Quilcene..... | Chum salmon, early..... | Aug. 23 to Oct. 6..... | 51 | 50 |
| | Chum salmon, late..... | Nov. 4 to Jan. 3..... | 45 | 45 |
| | Silver salmon..... | Oct. 20 to Jan. 20..... | 47 | 43 |
| Quinault..... | Steelhead salmon..... | Mar. 22 to June 1..... | 45 | 49 |
| | Chinook salmon..... | Oct. 1 to Nov. 15..... | 47 | 40 |
| | Silver salmon..... | Nov. 3 to Dec. 15..... | 42 | 40 |
| Sultan..... | Sockeye salmon..... |do..... | 42 | 40 |
| | Chinook salmon..... | Sept. 13 to Oct. 15..... | 51 | 47 |
| | Silver salmon..... | Oct. 8 to Feb. 2..... | 49 | 42 |
| | Steelhead salmon..... | Mar. 10 to May 28..... | 42 | 45 |

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, ETC.—Continued.

PACIFIC SALMON STATIONS—Continued.

| Station. | Species. | Spawning season. | Water temperatures, °F. | |
|--------------------------|------------------------------------|--------------------------|------------------------------|-------------------|
| | | | Begin- ning of season. | End of season. |
| Clackamas, Oreg..... | Chinook salmon..... | Sept. 19 to Nov. 15..... | 56 | 48 |
| Upper Clackamas..... | Chinook salmon, spring run..... | Aug. 25 to Sept. 24..... | 59 | 60 |
| Little White Salmon..... | Chinook salmon..... | Sept. 19 to Oct. 14..... | 47 | 46 |
| | Chum salmon..... | Oct. 28 to Dec. 2..... | 42 | 39 |
| | Silver salmon..... | Nov. 26 to Dec. 2..... | 41 | 39 |
| Big White Salmon..... | Chinook salmon..... | Sept. 19 to Oct. 15..... | 47 | 47 |
| Rogue River..... | Blackspotted trout..... | Mar. 29 to May 12..... | 40 | 46 |
| | Chinook salmon, spring run..... | Aug. 11 to Oct. 15..... | 56 | 40 |
| | Silver salmon..... | Oct. 10 to Nov. 25..... | 45 | 40 |
| | Steelhead salmon..... | Feb. 26 to May 10..... | 40 | 46 |
| Applegate Creek..... | Chinook salmon..... | Nov. 1 to Dec. 1..... | 42 | 40 |
| | Silver salmon..... | Nov. 18 to Mar. 1..... | 40 | 40 |
| | Steelhead salmon..... | Jan. 5 to May 19..... | 37 | 50 |
| Wahougal River..... | do..... | May 10 to June 2..... | 48 | 62 |
| Salmon, Idaho..... | Chinook salmon, spring run..... | Aug. 14 to Sept. 15..... | 63 | 60 |
| Baird, Calif.: | | | | |
| Battle Creek..... | Chinook salmon..... | Oct. 19 to Nov. 14..... | 48 | 49 |
| Mill Creek..... | do..... | Oct. 26 to Nov. 18..... | 54 | 52 |

GREAT LAKES STATIONS.

| | | | | |
|---|-------------------|-------------------------|----|----|
| Duluth, Minn.: Marquette, Mich..... | Lake trout..... | Oct. 10 to Nov. 10..... | | |
| Northville, Mich.: Charle- voix..... | do..... | Nov. 12 to 26..... | 48 | 45 |
| Put in Bay, Ohio: | | | | |
| Catawba Island..... | Whitefish..... | Nov. 13 to 29..... | 40 | 41 |
| North Bass Island..... | do..... | Nov. 10 to 29..... | 43 | 41 |
| Port Clinton..... | Carp..... | May 23 to June 13..... | 68 | 75 |
| | Pike perch..... | Apr. 5 to 24..... | 48 | 49 |
| | Whitefish..... | Nov. 13 to 29..... | 40 | 41 |
| | Pike perch..... | Apr. 8 to 24..... | 48 | 49 |
| Toledo..... | | | | |
| Cape Vincent, N. Y.: | | | | |
| Bygotts Point..... | Cisco..... | Nov. 22 to Dec. 1..... | 35 | 32 |
| | Whitefish..... | Nov. 10 to 23..... | 43 | 34 |
| Pigeon Island..... | Lake trout..... | Nov. 1 to 15..... | 50 | 48 |
| St. Lawrence River..... | Yellow perch..... | May 15 to June 15..... | 46 | 50 |

BRYANS POINT (MD.) STATION.

| | | | | |
|-----------------------|-------------------|-----------------------|------|----|
| Bryans Point, Md..... | Yellow perch..... | Mar. 10 to 23..... | 53 | 57 |
| | Shad..... | Apr. 22 to May 9..... | 56.5 | 57 |

MARINE STATIONS.

| | | | | |
|--------------------------|----------------------|---|----|----|
| Boothbay Harbor, Me..... | Flatfish..... | Mar. 10 to Apr. 22..... | 36 | 45 |
| Gloucester, Mass..... | Cod..... | Jan. 15 to Apr. 29..... | 38 | 48 |
| | Haddock..... | Jan. 22 to Apr. 25..... | 36 | 46 |
| | Pole flounder..... | May 22 to end of summer, probably..... | 56 | |
| | Pollock..... | Nov. 15 to Jan. 21..... | 46 | 36 |
| | Winter flounder..... | Mar. 18 to Apr. 22..... | 40 | 46 |
| Woods Hole, Mass..... | Cod..... | Nov. 26 to Feb. 1..... | 45 | 34 |
| | Winter flounder..... | Jan. 16 to Mar. 30..... | 38 | 43 |

NEW ENGLAND SALMON AND TROUT STATIONS.

| | | | | |
|------------------------|------------------------|-------------------------|----|----|
| Berkshire, Mass..... | Brook trout..... | Oct. 21 to Nov. 10..... | 44 | 44 |
| | Rainbow trout..... | Dec. 22 to Jan. 20..... | 44 | 40 |
| Craig Brook, Me..... | Atlantic salmon..... | Oct. 20 to Nov. 12..... | 55 | 46 |
| Green Lake, Me..... | Landlocked salmon..... | Nov. 10 to Dec. 1..... | 48 | 37 |
| | Smelt..... | Apr. 20 to 22..... | 51 | 51 |
| Grand Lake Stream..... | Landlocked salmon..... | Oct. 31 to Nov. 28..... | 54 | 36 |
| Nashua, N. H..... | Brook trout..... | Nov. 3 to Dec. 20..... | 48 | 47 |
| | Rainbow trout..... | Nov. 3 to Dec. 23..... | 48 | 46 |
| St. Johnsbury, Vt..... | Brook trout..... | Oct. 15 to Nov. 1..... | 54 | 43 |
| | Lake trout..... | do..... | 54 | 43 |

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, ETC.—Continued.

ROCKY MOUNTAIN TROUT STATIONS.

| Station. | Species. | Spawning season. | Water temperatures, °F. | |
|------------------------|----------------------------------|---------------------------|------------------------------|-------------------|
| | | | Begin- ning of season. | End of season. |
| Bozeman, Mont.: | | | | |
| Meadow Creek, Mont. | Rainbow trout..... | Apr. 15 to June 10..... | 43 | 54 |
| Yellowstone Park, Wyo. | Blackspotted trout..... | June 13 to July 22..... | 40 | 55 |
| Ledville, Colo..... | Brook trout..... | Oct. 10 to Dec. 7..... | 40 | 32 |
| Saratoga, Wyo..... | do..... | October and November..... | 51 | 41 |
| | Rainbow trout..... | April and May..... | 48 | 54 |
| | Loch Leven trout..... | October and November..... | 51 | 41 |
| Spearfish, S. Dak..... | Brook trout, brood stock..... | Oct. 25 to Jan. 14..... | 46 | 44 |
| | Loch Leven trout, wild fish..... | Oct. 16 to Dec. 12..... | 46 | 45 |
| | Rainbow trout, brood stock..... | Jan. 18 to Mar. 20..... | 44 | 39 |
| Springville, Utah: | | | | |
| Fish Lake..... | Brook trout..... | Nov. 1 to 14..... | 42 | 42 |
| | Rainbow trout..... | May 1 to June 4..... | 42 | 42 |

COMBINATION TROUT AND POND FISH-CULTURAL STATIONS.

| | | | | |
|-------------------------------|----------------------------|---------------------------|----|----|
| Erwin, Tenn..... | Brook trout..... | Oct. 1 to Jan. 1..... | 54 | 53 |
| | Carp..... | May 1 to July 1..... | 54 | 54 |
| | Catfish..... | June 1 to Oct. 20..... | 54 | 54 |
| | Largemouth black bass..... | Apr. 15 to June 1..... | 54 | 55 |
| | Rainbow trout..... | Nov. 1 to Jan. 15..... | 53 | 53 |
| | Rock bass..... | May 1 to Sept. 1..... | 54 | 54 |
| | Smallmouth black bass..... | Apr. 15 to June 1..... | 54 | 55 |
| | Sunfish..... | May 1 to Sept. 1..... | 54 | 54 |
| | Yellow perch..... | Mar. 1 to Apr. 30..... | 54 | 54 |
| Manchester, Iowa..... | Brook trout..... | Nov. 4 to Dec. 17..... | 50 | 50 |
| | Largemouth black bass..... | May 15 to June 1..... | 50 | 50 |
| | Rainbow trout..... | Dec. 22 to Apr. 19..... | 50 | 50 |
| | Rock bass..... | May 15 to June 1..... | 50 | 50 |
| Neosho, Mo..... | Crappie..... | April and May..... | 57 | 57 |
| | Largemouth black bass..... | Apr. 8 to June 20..... | 57 | 58 |
| | Rainbow trout..... | November to February..... | 57 | 57 |
| | Rock bass..... | Apr. 21 to July 18..... | 57 | 58 |
| | Smallmouth black bass..... | Apr. 22 to June 10..... | 57 | 58 |
| | Sunfish..... | May 10 to Sept. 1..... | 57 | 58 |
| | Yellow perch..... | Apr. 8 to 20..... | 57 | 57 |
| White Sulphur Springs, W. Va. | Brook trout..... | Nov. 15 to Dec. 13..... | 53 | 50 |
| | Largemouth black bass..... | May 1 to 25..... | 64 | 73 |
| | Rainbow trout..... | Nov. 11 to Jan. 31..... | 53 | 49 |
| | Rock bass..... | May 1 to June 15..... | 67 | 75 |
| | Smallmouth black bass..... | May 1 to 25..... | 64 | 73 |
| | Sunfish..... | May 1 to June 15..... | 67 | 75 |
| Wytheville, Va..... | Largemouth black bass..... | Apr. 15 to June 20..... | 60 | 60 |
| | Rainbow trout..... | Oct. 10 to Mar. 15..... | 54 | 54 |
| | Rock bass..... | May to July..... | 60 | 60 |
| | Smallmouth black bass..... | Apr. 15 to June 20..... | 60 | 60 |
| | Sunfish..... | May to July..... | 60 | 60 |

POND FISH-CULTURAL STATIONS.

| | | | | |
|--------------------------|----------------------------|-------------------------|----|----|
| Cold Springs, Ga..... | Catfish..... | May 1 to June 30..... | 64 | 80 |
| | Crappie..... | Apr. 1 to June 30..... | 61 | 80 |
| | Largemouth black bass..... | Mar. 15 to July 15..... | 64 | 72 |
| | Sunfish..... | Apr. 1 to July 31..... | 61 | 72 |
| Edenton, N. C..... | Largemouth black bass..... | Mar. 20 to June 15..... | 64 | 80 |
| | Sunfish..... | June 1 to July 15..... | 74 | 80 |
| Louisville, Ky..... | Largemouth black bass..... | Apr. 7 to 24..... | 60 | 64 |
| | Rock bass..... | Apr. 24 to June 15..... | 64 | 76 |
| | Smallmouth black bass..... | Apr. 11 to May 2..... | 60 | 61 |
| | Sunfish..... | Apr. 25 to June 30..... | 68 | 85 |
| | Yellow perch..... | Mar. 26 to Apr. 7..... | 58 | 58 |
| Mammoth Spring, Ark..... | Rock bass..... | May 1 to June 1..... | 59 | 60 |
| | Smallmouth black bass..... | Mar. 25 to May 7..... | 67 | 64 |

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, ETC.—Continued.

POND FISH-CULTURAL STATIONS—Continued.

| Stations. | Species. | Spawning season. | Water temperatures, °F. | |
|-----------------------|----------------------------|--|-----------------------------|-------------------|
| | | | Begin ning of season. | End of season. |
| Orangeburg, S. C..... | Catfish..... | Apr. 25 to June 30..... | 74 | 78 |
| | Crappie..... | Apr. 10 to June 30..... | 70 | 78 |
| | Smallmouth black bass..... | Mar. 15 to June 1..... | 63 | 76 |
| | Sunfish..... | Apr. 5 to June 30..... | 68 | 78 |
| San Marcos, Tex..... | Crappie..... | March through June, mainly. | | |
| | Largemouth black bass..... | Whole year, but mainly March through May. | | |
| Tupelo, Miss..... | Sunfish..... | Whole year..... | | |
| | Crappie..... | Apr. 5 to May 20..... | 68 | 77 |
| | Largemouth black bass..... | Mar. 15 to June 1..... | 69 | 82 |
| | Sunfish..... | Apr. 14 to June 20..... | 63 | 83 |

Fish Food Used at Fish-Cultural Stations.

AMOUNT AND COST OF FISH FOOD USED.

The ideal condition sought by all fish-culturists is a water area so arranged that a natural food supply is available when needed, but from our present knowledge the ideal is impossible of attainment in most cases and artificial feeding must be resorted to. In the rearing of fish under artificial environment, therefore, the problem of a satisfactory food supply at a reasonably low cost is ever present.

The following table gives for the fiscal year 1921 the number of pounds and the cost per pound of artificial fish food used at the various fish-cultural stations during the fiscal year 1921:

POUNDS AND COST PER POUND OF FISH FOOD USED, FISCAL YEAR 1921.

PACIFIC SALMON STATIONS.

| Station. | Salted salmon. | | Canned salmon. | | Frozen salmon eggs. | | Beef liver. | |
|--------------------------------------|----------------|---------|----------------|---------|---------------------|--------|-------------|--------|
| | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. |
| Afognak, Alaska..... | 860 | \$0.015 | | | | | | |
| Yes Bay, Alaska..... | 600 | .03 | | | | | | |
| Baker Lake and substations, Wash.. | 1,215 | .03 | | | | | 114 | \$0.15 |
| Quinault, Wash..... | 3,000 | .015 | | | | | | |
| Clackamas, Oreg., and substations... | 23,260 | .03 | 9,000 | \$0.001 | 9,440 | \$0.04 | | |
| Baird, Calif., and substations..... | 8,000 | .01 | | | | | 880 | .11 |
| Total..... | 56,875 | | 9,000 | | 9,440 | | 994 | |

| Station. | Beef spleen. | | Pork liver. | | Milk. | | Wheat mid- dling. | |
|--------------------------------------|--------------|--------|-------------|--------|-------|--------|----------------------|--------|
| | Lbs. | Cost. | Lbs. | Cost. | Gals. | Cost. | Lbs. | Cost. |
| Afognak, Alaska..... | | | | | | | | |
| Yes Bay, Alaska..... | | | | | | | | |
| Baker Lake and substations, Wash.. | 2,886 | \$0.05 | | | 176 | \$0.25 | | |
| Quinault, Wash..... | | | 2,230 | \$0.07 | | | | |
| Clackamas, Oreg., and substations... | 10,395 | .045 | | | | | 760 | \$0.03 |
| Baird, Calif., and substations..... | | | | | | | | |
| Total..... | 13,281 | | 2,230 | | 176 | | 760 | |

POUNDS AND COST PER POUND OF FISH FOOD USED, FISCAL YEAR 1921—Continued.
NEW ENGLAND SALMON AND TROUT STATIONS.

| Station. | Beef liver. | | Beef hearts. | | Beefspleen. | | Sheep liver. | | Pork liver. | | Fishotine. | |
|--------------------------------------|-------------|--------|--------------|--------|-------------|--------|--------------|--------|-------------|--------|------------|--------|
| | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. |
| Berkshire trout hatchery, Mass. | 1,336½ | \$0.13 | | | 4,100 | \$0.05 | 372 | \$0.05 | 347 | \$0.07 | | |
| Craig Brook, Me. | 192 | .12 | | | | | | | | | | |
| Green Lake, Me. | 352 | .10 | | | | | 80 | .07 | 170 | .05½ | | |
| Nashua, N. H. | 1,263 | .08 | 215 | \$0.05 | | | 1,337 | .04½ | 512 | .06 | | |
| St. Johnsbury, Vt. | 758½ | 1.08 | | | | | | | | | 57 | \$0.09 |
| Total..... | 3,892½ | | 215 | | 4,100 | | 1,789 | | 1,029 | | 57 | |

ROCKY MOUNTAIN TROUT STATIONS.

| Station. | Beef liver. | | Beef hearts. | | Beefspleen. | | Sheep liver. | | Wheat chop. | |
|-------------------------|-------------|--------|--------------|---------|-------------|--------|--------------|---------|-------------|---------|
| | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. |
| Bozeman, Mont. | 9,649 | \$0.09 | | | | | | | | |
| Leadville, Colo. | 32 | .12½ | 2,711 | \$0.08½ | | | | | | |
| Spearfish, S. Dak. | 922 | .12 | 1,280 | .12 | | | 2,680 | \$0.07½ | | |
| Springville, Utah. | 4,234 | .07 | 1,018 | .07 | 1,770 | \$0.05 | 8,064 | .06 | 4,000 | \$0.03½ |
| Saratoga, Wyo. | 3,997 | 1.08 | | | | | 835 | .04 | | |
| Total..... | 18,834 | | 5,009 | | 1,770 | | 11,579 | | 4,000 | |

COMBINED TROUT AND POND FISH-CULTURAL STATIONS.

| Station. | Beef liver. | | Beef hearts. | | Sheep liver. | | Sheep hearts. | |
|------------------------------------|-------------|--------|--------------|---------|--------------|---------|---------------|---------|
| | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. |
| Erwin, Tenn. | | | 2,896 | \$0.08½ | 6,431 | \$0.06½ | | |
| Manchester, Iowa. | | | 2,637 | .06½ | 13,697 | .03½ | | |
| Neosho, Mo. | | | 385 | .06½ | 10,919 | .04 | | |
| White Sulphur Springs, W. Va. | 74 | \$0.09 | 2,903 | .06½ | 21,387½ | .04 | 8,275 | \$0.04½ |
| Wytheville, Va. | | | 2,705 | .08½ | 6,882 | .06 | | |
| Total..... | 74 | | 11,526 | | 59,316½ | | 8,275 | |

| Station. | Canned herring milt. | | Meatcin. | | Azotine. | | Shorts. | |
|------------------------------------|----------------------|--------|----------|--------|----------|---------|---------|---------|
| | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. |
| Erwin, Tenn. | 96 | \$0.14 | 200 | \$0.08 | | | 5,300 | \$0.04½ |
| Manchester, Iowa. | | | | | | | 200 | .03½ |
| Neosho, Mo. | | | | | | | 4,000 | .03 |
| White Sulphur Springs, W. Va. | 96 | .14 | | | | | | |
| Wytheville, Va. | | | | | 250 | \$0.07½ | 5,825 | .03½ |
| Total..... | 192 | | 200 | | 250 | | 15,325 | |

POND FISH-CULTURAL STATIONS.²

| Station. | Beef liver. | | Beef hearts. | | Fresh fish. | | Fishotine. | | Shorts. | |
|---------------------------|-------------|--------|--------------|---------|-------------|---------|------------|---------|---------|--------|
| | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. | Lbs. | Cost. |
| Cold Springs, Ga. | | | 285½ | \$0.08½ | 5,154 | \$0.16½ | 400 | \$0.09½ | 400 | \$0.04 |
| Edenton, N. C. | 56½ | \$0.20 | | | 269½ | .15½ | | | | |
| Louisville, Ky. | | | 289 | .15 | | | | | | |
| Mammoth Spring, Ark. | | | 446½ | .12 | | | | | | |
| Orangeburg, S. C. | | | 971 | .12½ | | | | | | |
| Tupelo, Miss. | | | 1,908 | .11 | | | | | | |
| Total..... | 56½ | | 3,900½ | | 5,423½ | | 400 | | 400 | |

¹ Beef liver and hearts combined.² No artificial foods used at the San Marcos (Tex.) station.

FOOD FOR BASS.

One of the principal problems encountered at most of the pond fish-cultural stations pertains to a suitable food supply for both young and adult bass. At the Cold Springs (Ga.) station fresh mullet was for a number of years the staple food for the bass, but this material has not given entire satisfaction, and recently the price has been prohibitive. Beef hearts and groupers have been tried, but the fish show some reluctance in accepting either of these materials. More recently pork hearts have been tried with very satisfactory results.

TESTS WITH HERRING MILT AS FOOD FOR RAINBOW TROUT.

During the past year the bureau has purchased several cases of canned herring milt for the purpose of testing its value as a food for young rainbow trout. It has been tried at several hatcheries, and while the results of the tests made in comparison with other foods in more general use are not necessarily conclusive they seem to indicate that canned herring milt when used alone is not a satisfactory article of diet for young trout, though when used in combination with a meat product it may perhaps be considered a desirable article for the fish-culturists to keep on hand as an emergency food. It has the advantage of being easily prepared, does not "smoke" or discolor the water, and will keep for a long period.

A noticeable feature in connection with this experiment is that for a short period—ranging from 10 to 17 days—the fish receiving herring milt exclusively appeared to thrive equally as well as those receiving a meat diet and the mortality was not greater, but beyond that time the death rate increased so rapidly that in most cases the experiments were discontinued, as it appeared that none of the fish would survive under the treatment. A change to the usual foods appears to have restored normal conditions among the fish.

The tabulated statement of the results of these tests in feeding may be of interest. Rainbow trout were involved exclusively, and in each instance the fish had not previously received artificial food.

RESULTS OF TESTS WITH HERRING MILT AS FOOD FOR RAINBOW TROUT.

ERWIN (TENN.) STATION.

[Test continued for 16 days—2,500 fish per trough.]

| Trough number. | Food used. | Weight per 1,000 fish— | | | Loss per 1,000 fish during test. |
|----------------|--------------------------|------------------------|-----------------|---------------------|----------------------------------|
| | | At beginning of test. | At end of test. | Gained during test. | |
| | | Ounces. | Ounces. | Ounces. | Per cent. |
| 1..... | Beef heart..... | 6 | 8 | 2 | 74 |
| 2..... | Canned herring milt..... | 6 | 7 | 1 | 24 |

RESULTS OF TESTS WITH HERRING MILT AS FOOD FOR RAINBOW TROUT—Contd.

NEOSHO (MO.) STATION.

[Test continued for 30 days—2,000 fish per trough.]

| Trough number. | Food used. | Weight per 1,000 fish. | | | Loss per 1,000 fish during test. |
|----------------|--|------------------------|-----------------|---------------------|----------------------------------|
| | | At beginning of test. | At end of test. | Gained during test. | |
| | | Ounces. | Ounces. | Ounces. | Per cent. |
| 1..... | Canned herring milt 3 days, beef hearts 3 days, alternately..... | 6 | 12½ | 6½ | 1½ ₁₀ |
| 2..... | Canned herring milt 3 days, sheep liver 3 days, alternately..... | 6 | 11½ | 5½ | 5½ |
| 3..... | Beef heart..... | 6 | 19¾ | 13¾ | 1½ |
| 4..... | Sheep liver..... | 6 | 12 | 6 | 4½ ₁₀ |

WHITE SULPHUR SPRINGS (W. VA.) STATION.

[Test continued for 20 days—10,000 fish per trough.]

| | | | | | |
|--------|--|----|----|---|------------------|
| 1..... | Canned herring milt..... | 4½ | 8¼ | 4 | 12½ |
| 2..... | Sheep liver..... | 4½ | 9½ | 5 | 1½ ₁₀ |
| 3..... | Canned herring milt 10 days, sheep liver 10 days, alternately..... | 4½ | 9 | 5 | 1½ ₁₀ |

WYTHEVILLE (VA.) STATION.

[Test continued for 10 days—13,000 fish per trough.]

| | | | | | |
|--------|--------------------------|----|----|----|------------------|
| 1..... | Canned herring milt..... | 4½ | 5 | ½ | 7½ ₁₀ |
| 2..... | Beef heart..... | 4½ | 6¼ | 1½ | 3½ ₁₀ |

Rescue Operations.

[C. F. CULLER, in Charge.]

OUTLINE OF POSSIBLE EXTENSION.

So much has already been said regarding the importance of the rescue operations conducted in the Mississippi Basin, their value, simplicity, practical returns, and comparatively low cost that these phases of the work should be familiar to all interested persons. A brief outline of the possibilities of extending the work, with suggestions as to its requirements, may not be out of place, in view of the bill now pending before Congress to provide funds for enlarging its scope. Almost unlimited possibilities exist for the further extension of the work. In the bureau's greatest effort during the fiscal year 1920, when approximately 160,000,000 of fishes were saved, not more than 40 per cent of the available territory was covered. There are many miles of unbroken stretches of river lowlands where floods annually result in the destruction of millions of fish, while the major tributaries of the Mississippi afford a field of unknown possibilities. For the economical and efficient conduct of the work it would be desirable to establish headquarters near the central point of the more important operations, with a personnel available for its prosecution at all times. Under present arrangements the personnel for the rescue work is drawn from four of the regularly established

fish-cultural stations. This diversion is apt to result in a comparative lack of interest in the work of the home stations, and not infrequently it curtails their operations. Moreover, men drawn from other lines of activities can not be expected to be as familiar or as efficient in the prosecution of the rescue work as will men who can devote all their time to it. The work has grown to such proportions that men drawn from the fish-cultural stations can no longer handle it to the fullest advantage under such conditions.

The rescue field would afford profitable employment for such a force throughout the year, the line of operations to be something as follows: Rescue of fishes along the upper reaches of the river would occupy the attention of the men from July to December, during which time a crew of five men could save from 8,000,000 to 10,000,000 fish, at a total approximate cost of \$2,000. That number of fish purchased from commercial fish-culturists would cost the bureau from \$25,000 to \$30,000 and to citizens of the Mississippi Valley would represent a food value of \$1,000,000 to \$1,500,000 when placed on the market three years after being rescued. These figures are very conservative when compared with the results attained at the bureau's regularly established fish-cultural stations. At the close of the rescue season important work in the salvage of eggs in connection with the commercial fisheries in Louisiana would consume practically all the time of the men from February to April. From Louisiana the crew would work northward to the confluence of the Ohio and the Mississippi Rivers, where important fields are open in the three adjoining States. The Illinois River overflows its dikes during the spring freshets, and in May or early June large pumps are operated to remove the water from the land. Many millions of young fish are thus left in the fields to perish or are passed through the pumps and destroyed. During the comparatively short periods when active rescue work is not under way the time could be profitably employed in repair and maintenance of the equipment used.

In addition to a personnel provided especially for the rescue work there should be two or three additional holding stations, these being essential for the "hardening" of the fish required for distribution. A part of the rescued fish are held in tanks of clear water and "hardened" for several days to enable them to withstand transportation. They are then shipped in the bureau's specially equipped distribution cars and planted in suitable tributary waters. Experience has shown that greater results can be attained in this way than by returning all fish rescued to the main river. The wider distribution also gives to people living in various parts of the Mississippi Valley a better opportunity to obtain fresh fish.

In addition to the requirements outlined above, houseboats with living quarters for a crew of five or six men should be provided. These boats would be placed in certain sections of the river, and when the pools at one point had been cleaned up they would be moved downstream to other fields. Launches will be needed to transport the crews to and from the fields of operation, to carry supplies, and to distribute fish. It has been found more economical to own launches than to rent them. Boats for hire are seldom in good running condition, and much valuable time is lost in repairs before the men can be placed in the field. There will be necessity for a boathouse and

storeroom at a central point for the proper housing of boats and equipment; also for two dwelling houses to serve as quarters for the men in immediate charge of the work.

Since the Mississippi River is largely a boundary water, most of the States regard the rescue operations as a work belonging to the Federal Government rather than to the States. Most of the States have rendered excellent cooperation; but in many cases their appropriations for rescue and fish-cultural work have been more or less sporadic, hence the work could not be well organized nor efficiently handled. Moreover, most of the States have a problem in maintaining the fish in their interior waters.

Citizens throughout the Mississippi Valley have urged the bureau to extend this valuable work, arguing that they are entitled to fresh fish as a food, and that it should not be necessary for them to depend upon the Pacific coast, the Atlantic coast, or the Great Lakes for their supply. They can not understand why an earnest effort should not be made to save the millions of fish that are dying in pools along the river.

METHODS EMPLOYED IN RESCUING FISH.

A rescue crew usually consists of five men and a foreman. A launch is employed in going to and from the field of operations, and the equipment for each field comprises two seines of one-fourth-inch mesh, from 50 to 75 feet long and 5 feet deep; six galvanized-iron tubs of $1\frac{1}{2}$ -bushel capacity; small dip nets; two tin dippers; and a small flat-bottomed boat, the latter being used in ponds too deep for wading.

After making a haul the fish are assorted into tubs by species and size. The number per tub is ascertained by noting the water displacement, one or more rings having been made on the inside of each tub, and the number established by actual count. The count is verified several times during the season, as the fish in some instances are subject to rapid growth.

When first taken from the warm water the fish will not safely stand a long railway journey. Therefore those intended for distribution are taken to the nearest holding station and hardened by being held for several days in cool running water. While the number of fish diverted for supplying applicants at a distance may seem large in the aggregate, it represents less than 1 per cent of the total collections. Such diversions during the fiscal year 1921 amounted to 660,110 fish of miscellaneous species.

REVIEW OF THE WORK.

The aggregate number of fish rescued during the fiscal year 1921 amounted to 120,656,420, a decrease of almost 36,000,000 as compared with the record of the previous year. Two causes contributed to this result. Labor conditions were unsatisfactory, making it difficult to obtain efficient crews at all points at the rate of compensation offered. The river remained at a high stage for a longer period than usual, thus permitting large numbers of fish bred in the overflow waters to return to the river unaided. This appears to have been particularly true with reference to such species as the carp, buffalofish, and catfish.

The work began at Prescott, Wis., on August 12 and was brought to a close at Bellevue, Iowa, on November 10, these dates indicating an unusually short season on account of the natural conditions mentioned. The work was conducted in the following fields:

One crew, with house boat, from Prescott, Wis., to Red Wing, Minn.; thence to Genoa, Wis.

Two crews on house boats from Wabash to Winona, Minn.; thence to Dakota and Dressback, Minn.

Two crews from Homer, Minn.

One crew from La Crosse, Wis.

One crew from Genoa, Wis.

One crew from Ferryville, Wis.

Two crews from Lynxville, Wis.

One crew from Marquette, Iowa.

One crew with house boat from Dubuque to Bellevue, Iowa.

One crew from Bellevue, Iowa.

In addition to the regular rescue work collections of eggs from carp and buffalofish taken by commercial fishermen were made at Bellevue and Lynxville. The eggs were taken, fertilized, and planted on the natural spawning grounds. Such work was done from May 9 to 25 and resulted in the fertilization of 68,287,000 buffalofish and 42,718,000 carp eggs. Had these eggs not been thus handled they would have been sent to the markets in the fish and lost. While the planting of fertilized eggs is not considered as efficient as incubating them in a well-equipped hatchery, it is believed that under certain conditions it is expedient and results in much good if properly done.

In addition to the operations on the upper Mississippi rescue work was conducted from the Fairport (Iowa) biological station; also on the Illinois River at Meredosia and Cairo, Ill., and at San Marcos, Tex. The operations from Fairport and substations were in conjunction with the propagation of the fresh-water mussel, large numbers of the rescued fish being inoculated with the mussel glochidia before being liberated. Owing to unfavorable water stages the active season at Cairo was very short, extending only from October 1 to 19. In this field one seining crew working under the direction of the superintendent of the Louisville (Ky.) station salvaged a total of 1,057,215 fish of miscellaneous species at a total cost of \$582.07, or at the rate of 55 cents per thousand fish handled. In the vicinity of the San Marcos (Tex.) station 202,886 black bass, catfish, and sunfish were removed from the bed of a stream, which almost entirely evaporated during a protracted hot spell, and were deposited in living waters. Reference to the table on page 7 will show the points from which rescue work was prosecuted during the season, the number of fishes salvaged at each and restored to the original waters, and the number delivered to applicants.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS.

Extent and Character of the Work.

[E. C. FEARNOW, Superintendent of Fish Distribution.]

BRIEF REVIEW OF THE WORK.

The 4,962,489,405 fish and fish eggs (see table, p. 5) representing the net product of the hatcheries and rescue stations of the bureau for

the fiscal year 1921 were widely disseminated, the distribution reaching practically every State in the Union and the Territories of Alaska and Hawaii. Consignments of fish eggs were also shipped to the Governments of Canada, France, and Switzerland, and an allotment of fish was forwarded to an applicant in Mexico.

Fully 93 per cent of the output is represented by important commercial species—the salmons, shad, whitefish, pike perch, yellow perch, lake trout, cod, pollock, haddock, flounder, buffalofish, and carp. All of such fishes are planted on or adjacent to the spawning areas where the eggs originate, or the eggs are consigned to State commissions for incubation and distribution in nonproductive waters where conditions appear to favor the development of new fisheries. (See p. 87.) Included under the head of the commercial fishes are the large numbers of food fish annually salvaged from the overflowed territory along the Mississippi River and at other points (see pp. 7 and 78), a branch of the work that has become one of the most popular, practical, and beneficial of the bureau's activities.

Among the more important species propagated for the stocking of interior waters are the brook, rainbow, and blackspotted trouts, the largemouth and smallmouth black basses, rock bass, sunfish, crappies, and catfish. While the numbers of such fishes are by comparison small, representing only 7 per cent of the aggregate output, the importance of this work is not to be underestimated. It is this branch of its work which brings the bureau in close contact with the general public, as is evidenced by the large number of applications received each year, and the interest thus aroused in the fisheries can not be other than beneficial. The economic value of the work is large. In most instances the reports received from applicants regarding the results obtained from planting fish furnished by the bureau are of a highly satisfactory nature. (See p. 88.)

SUMMARY OF DISTRIBUTION TO ALL APPLICANTS.

The following table shows in summarized form how many and what species of fish and fish eggs out of the net product of the hatcheries and rescue stations for the fiscal year 1921 were delivered to all applicants, both in the United States and Territories and in foreign countries. Only a small percentage of the immense numbers of fish rescued from overflowed lands was delivered to applicants, the great bulk having been returned to the original waters, as is shown in the table on page 7.

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS TO ALL APPLICANTS,
FISCAL YEAR 1921.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings.]

UNITED STATES AND TERRITORIES.

| State and species. | Number. | State and species. | Number. |
|------------------------------------|-----------------|----------------------------|-------------|
| Alabama: | | Illinois: | |
| Carp..... | 45 | Brook trout..... | 500 |
| Catfish..... | 2,240 | Buffalofish..... | 141,653 |
| Crappie..... | 1,900 | Carp..... | 125,211 |
| Largemouth black bass..... | †153,550 | Catfish..... | 1,546,730 |
| Rock bass..... | 46,565 | Crappie..... | 148,204 |
| Sunfish..... | 4,000 | Drum..... | 175 |
| | 45,300 | Lake trout..... | *10,000 |
| Alaska: Sockeye salmon..... | *350,000 | Largemouth black bass..... | 8,741 |
| | †30,761,000 | Pike and pickerel..... | 410 |
| | 26,977,500 | Pike perch..... | 250 |
| Arizona: | | Rainbow trout..... | *1,000 |
| Brook trout..... | 73,000 | Rock bass..... | 900 |
| Catfish..... | 1,200 | Sunfish..... | 208,350 |
| Crappie..... | 2,775 | White bass..... | 2,510 |
| Rainbow trout..... | 37,000 | Whitefish..... | *2,000,000 |
| Rock bass..... | 200 | Yellow perch..... | 100 |
| Sunfish..... | 1,000 | Miscellaneous fishes..... | 16,390 |
| Yellow perch..... | 300 | | |
| Arkansas: | | Indiana: | |
| Catfish..... | 5,620 | Brook trout..... | †24,000 |
| Crappie..... | 6,520 | Carp..... | 22,500 |
| Largemouth black bass..... | †39,000 | Catfish..... | 25 |
| Rainbow trout..... | 24,461 | Crappie..... | 1,980 |
| Rock bass..... | 49,061 | | 1,040 |
| Smallmouth black bass..... | 10,140 | Largemouth black bass..... | †12,000 |
| Sunfish..... | †25,500 | Rainbow trout..... | 8,775 |
| Yellow perch..... | 2,639 | Rock bass..... | 18,500 |
| | 20,120 | Smallmouth black bass..... | 600 |
| | 1,000 | Sunfish..... | 12,900 |
| California: | | Yellow perch..... | 2,760 |
| Chinook salmon..... | *3,000,000 | | 2,275 |
| Rainbow trout..... | 4,593,400 | | |
| Steelhead salmon..... | *25,000 | Iowa: | |
| | *20,000 | Brook trout..... | 11,775 |
| Colorado: | | Buffalofish..... | †68,267,000 |
| Blackspotted trout..... | †868,500 | Carp..... | 557,590 |
| Brook trout..... | †27,000 | | †42,718,000 |
| Lake trout..... | 2,004,050 | Catfish..... | 528,902 |
| Largemouth black bass..... | 24,000 | Crappie..... | 3,272,437 |
| Loch Leven trout..... | 9,725 | Drum..... | 6,405,468 |
| Rainbow trout..... | 34,000 | Lake trout..... | 2,120 |
| Sunfish..... | *200,000 | Largemouth black bass..... | *50,000 |
| | 62,500 | Pike perch..... | 44,797 |
| | 600 | Rainbow trout..... | 37,560 |
| Connecticut: | | Rock bass..... | *64,500 |
| Brook trout..... | 135,600 | Smallmouth black bass..... | 5,500 |
| Catfish..... | 2,400 | Sunfish..... | 47,000 |
| Largemouth black bass..... | 2,380 | White bass..... | 1,500 |
| Pike perch..... | †150,000 | Yellow perch..... | 5,230,707 |
| Rainbow trout..... | 13,000 | Miscellaneous fishes..... | 9,410 |
| Delaware: Pike perch..... | †500,000 | | 223,175 |
| District of Columbia: | | | 3,487,105 |
| Rainbow trout..... | 13,500 | Kansas: | |
| Shad..... | †800,000 | Catfish..... | 250 |
| Florida: | | Largemouth black bass..... | 240 |
| Largemouth black bass..... | 2,450 | Rainbow trout..... | 1,625 |
| Sunfish..... | 400 | Sunfish..... | 200 |
| Georgia: | | Yellow perch..... | 800 |
| Brook trout..... | 38,000 | Kentucky: | |
| Catfish..... | 3,060 | Buffalofish..... | 107,350 |
| Crappie..... | 300 | Carp..... | 44,715 |
| Largemouth black bass..... | †82,500 | Catfish..... | 673,400 |
| Rainbow trout..... | 45,405 | Crappie..... | 172,400 |
| Rock bass..... | 70,000 | Largemouth black bass..... | †20,000 |
| Sunfish..... | 100 | Pike perch..... | 6,675 |
| Warmouth bass..... | 37,250 | Rainbow trout..... | 4,900 |
| Hawaii: Rainbow trout..... | *25,000 | Rock bass..... | 500 |
| Idaho: | | Smallmouth black bass..... | 4,775 |
| Blackspotted trout..... | *50,000 | Sunfish..... | †146,000 |
| Brook trout..... | 23,000 | White bass..... | 2,500 |
| Landlocked salmon..... | 29,275 | Yellow perch..... | 131,750 |
| Rainbow trout..... | *15,000 | | 800 |
| Whitefish..... | †128,000 | Louisiana: | |
| | 27,000 | Buffalofish..... | †10,646,000 |
| | *500,000 | Catfish..... | 150 |
| | †500,000 | Crappie..... | 600 |
| | | Largemouth black bass..... | 530 |
| | | | 150 |

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS, ETC.—Continued.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings.]

UNITED STATES AND TERRITORIES—Continued.

| State and species. | Number. | State and species. | Number. |
|----------------------------|----------------|-----------------------------|--------------|
| Maine: | | Minnesota—Continued. | |
| Atlantic salmon..... | { †1,387,000 | Crappie..... | 15,929,225 |
| Brook trout..... | { *256,890 | Drum..... | 19,405 |
| Flounder (winter)..... | { †1,730,930 | Lake trout..... | { †670,000 |
| Lake trout..... | { †841,235,000 | Largemouth black bass..... | 20,000 |
| Landlocked salmon..... | { *50,000 | Pike and pickerel..... | 153,765 |
| Pollock..... | { *375,000 | Pike perch..... | 175,040 |
| Rainbow trout..... | { †208,115 | Rainbow trout..... | { †2,500,000 |
| Smelt..... | { 108,400 | Steelhead salmon..... | 56,400 |
| Sockeye salmon..... | { †11,906,000 | Smallmouth black bass..... | 1,000 |
| | { †26,000 | Steelhead salmon..... | *70,000 |
| | { †7,000,000 | Sunfish..... | 11,727,380 |
| | { †17,500 | White bass..... | 6,990 |
| Maryland: | | Whitefish..... | †100,000 |
| Brook trout..... | 18,700 | Yellow perch..... | 4,912,812 |
| Catfish..... | 1,500 | Miscellaneous fishes..... | 527,080 |
| Chinook salmon..... | 2,500 | Mississippi: | |
| Cisco..... | *300,000 | Carp..... | 84 |
| Crappie..... | 2,180 | Catfish..... | 2,460 |
| Lake trout..... | *4,000 | Crappie..... | 1,344 |
| Largemouth black bass..... | 4,350 | Largemouth black bass..... | { †165,500 |
| Pike perch..... | *1,000,000 | Rainbow trout..... | 37,640 |
| Rainbow trout..... | { *150,000 | Rock bass..... | 5,000 |
| Rock bass..... | { 37,750 | Rock bass..... | 300 |
| Shad..... | 360 | Sunfish..... | 49,030 |
| Sunfish..... | †7,436,250 | Yellow perch..... | 100 |
| Whitefish..... | 4,260 | Missouri: | |
| Whitefish..... | *100,000 | Buffalofish..... | 8,395 |
| Yellow perch..... | { †85,205,850 | Carp..... | 19,684 |
| | { 300 | Catfish..... | 269,638 |
| Massachusetts: | | Crappie..... | 130,570 |
| Brook trout..... | 257,525 | Drum..... | 420 |
| Carp..... | 100 | Largemouth black bass..... | 21,361 |
| Catfish..... | 7,400 | Pike perch..... | 470 |
| Cod..... | { *208,800,000 | Rainbow trout..... | 59,329 |
| Flounder (pole)..... | { †175,341,000 | Rock bass..... | 4,125 |
| Flounder (winter)..... | { *19,410,000 | Smallmouth black bass..... | 2,260 |
| Haddock..... | { †848,993,000 | Sunfish..... | 51,680 |
| Largemouth black bass..... | { *188,940,000 | White bass..... | 840 |
| Pike perch..... | { †271,880,000 | Yellow perch..... | 768 |
| Pollock..... | { 550 | Miscellaneous fishes..... | 480 |
| Pike perch..... | { †725,000 | Montana: | |
| Pollock..... | { †443,160,000 | Blackspotted trout..... | { *350,000 |
| Rainbow trout..... | { *50,000 | Brook trout..... | { †854,000 |
| Smallmouth black bass..... | { 29,600 | | { 522,500 |
| Sunfish..... | { †12,000 | Brook trout..... | { *200,000 |
| | { 180 | | { 436,175 |
| Michigan: | | Catfish..... | 1,600 |
| Blackspotted trout..... | { *10,000 | Grayling..... | †1,400,000 |
| Brook trout..... | { †264,000 | Largemouth black bass..... | 1,350 |
| Carp..... | { 500,375 | Rainbow trout..... | { *225,000 |
| Catfish..... | { 200 | | { †250,000 |
| Crappie..... | { 6,950 | Steelhead salmon..... | 758,000 |
| Lake trout..... | { 640 | | *75,000 |
| Landlocked salmon..... | { *1,000,000 | Nebraska: | |
| Largemouth black bass..... | { †14,875,000 | Brook trout..... | { †32,900 |
| Pike perch..... | { *10,000 | Largemouth black bass..... | 39,000 |
| Rainbow trout..... | { 16,400 | Rainbow trout..... | 1,000 |
| Rock bass..... | { *277,250,000 | | 43,000 |
| Smallmouth black bass..... | { †8,010,000 | Nevada: Rainbow trout..... | { *50,000 |
| Sunfish..... | { †34,000 | | { 23,000 |
| Whitefish..... | { 64,975 | New Hampshire: | |
| Yellow perch..... | { 600 | Brook trout..... | { †381,000 |
| | { 19,351 | Catfish..... | { 519,500 |
| | { *100,000 | Lake trout..... | { *25,000 |
| | { †23,810 | | { †12,000 |
| | { 1,675 | Landlocked salmon..... | 1,400 |
| | { *20,000,000 | | *20,000 |
| | { †29,500,000 | | 5,850 |
| | { 1,200 | Pike perch..... | *2,000,000 |
| Minnesota: | | | †500,000 |
| Brook trout..... | 78,820 | Rainbow trout..... | 33,000 |
| Buffalofish..... | 30,175 | Smallmouth black bass..... | †14,200 |
| Carp..... | 1,190,320 | Steelhead salmon..... | 545 |
| Catfish..... | 10,746,580 | Whitefish..... | *250,000 |

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS, ETC.—Continued.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings].

UNITED STATES AND TERRITORIES—Continued.

| State and species. | Number. | State and species. | Number. |
|----------------------------|-------------------------------|----------------------------|----------------------------|
| New Jersey: | | Ohio—Continued. | |
| Brook trout..... | 7,400 | Yellow perch..... | { \$300,000 300 |
| Catfish..... | 600 | Oklahoma: | |
| Crappie..... | 400 | Catfish..... | 2,250 |
| Largemouth black bass..... | 4,040 | Crappie..... | 4,350 |
| Pike perch..... | { *1,000,000 †1,050,000 | Largemouth black bass..... | 2,720 |
| Rainbow trout..... | 4,000 | Rainbow trout..... | { *100,000 56,400 |
| Sunfish..... | 4,800 | Rock bass..... | 1,350 |
| Yellow perch..... | 100 | Sunfish..... | 2,000 |
| New Mexico: | | Yellow perch..... | 2,200 |
| Blackspotted trout..... | †73,500 | Oregon: | |
| Brook trout..... | 492,000 | Black-spotted trout..... | 101,500 |
| Catfish..... | 3,600 | Brook trout..... | 4,000 |
| Crappie..... | 3,755 | Chinook salmon..... | { *3,650,000 10,682,900 |
| Largemouth black bass..... | 900 | Rainbow trout..... | { *604,940 189,500 |
| Rock bass..... | 1,400 | Shad..... | †2,347,100 |
| Sunfish..... | 1,400 | Silver salmon..... | 417,050 |
| Yellow perch..... | 100 | Steelhead salmon..... | 1,316,000 |
| New York: | | Pennsylvania: | |
| Blackspotted trout..... | *10,000 | Brook trout..... | { \$3,000 613,475 |
| Brook trout..... | { †446,000 42,000 | Carp..... | 85 |
| Carp..... | 100 | Catfish..... | 11,600 |
| Catfish..... | 7,200 | Chinook salmon..... | 10,000 |
| Cisco..... | { *121,210,000 †89,800,000 | Cisco..... | *65,000,000 |
| Crappie..... | 750 | Crappie..... | 3,050 |
| Lake trout..... | { *1,510,000 †456,000 | Lake trout..... | *50,000 |
| Landlocked salmon..... | 5,550 | Landlocked salmon..... | *10,000 |
| Largemouth black bass..... | *125,000 | Largemouth black bass..... | 24,870 |
| Pike perch..... | { 4,000 *525,000 | Pike perch..... | †2,174,200 |
| Rainbow trout..... | { †10,495,800 *10,000 | Rainbow trout..... | 396,701 |
| Steelhead salmon..... | { †65,100 1,900 | Rock bass..... | 200 |
| Whitefish..... | *199,000 | Smallmouth black bass..... | 125 |
| Yellow perch..... | 2,500 | Steelhead salmon..... | *55,000 |
| North Carolina: | | Sunfish..... | 11,800 |
| Brook trout..... | 253,500 | Whitefish..... | *10,000,000 |
| Crappie..... | 950 | Yellow perch..... | 1,175 |
| Glut herring..... | †43,815,000 | Rhode Island: | |
| Largemouth black bass..... | { †5,500 102,580 | Brook trout..... | 23,000 |
| Rainbow trout..... | 453,100 | Flounder (winter)..... | †78,432,000 |
| Rock bass..... | 11,200 | Largemouth black bass..... | 150 |
| Shad..... | †15,756,000 | Smallmouth black bass..... | †5,500 |
| Smallmouth black bass..... | 1,635 | South Carolina: | |
| Striped bass..... | †20,184,000 | Crappie..... | 300 |
| Sunfish..... | 27,520 | Largemouth black bass..... | 117,875 |
| North Dakota: | | Rainbow trout..... | 16,000 |
| Carp..... | 5 | Sunfish..... | 5,000 |
| Catfish..... | 800 | South Dakota: | |
| Crappie..... | 500 | Brook trout..... | 379,100 |
| Largemouth black bass..... | 6,380 | Catfish..... | 400 |
| Rock bass..... | 400 | Crappie..... | 375 |
| Ohio: | | Loch Leven trout..... | 2,000 |
| Brook trout..... | †33,000 | Lake trout..... | 5,000 |
| Buffalofish..... | 1,000 | Largemouth black bass..... | 3,850 |
| Carp..... | †63,325,000 | Rainbow trout..... | 84,110 |
| Catfish..... | 6,375 | Sunfish..... | 500 |
| Crappie..... | 1,800 | Tennessee: | |
| Largemouth black bass..... | 14,380 | Brook trout..... | 13,935 |
| Pike perch..... | †12,600,000 | Catfish..... | 5,100 |
| Rainbow trout..... | †10,000 | Crappie..... | 4,050 |
| Rock bass..... | 600 | Largemouth black bass..... | { †86,000 23,955 |
| Smallmouth black bass..... | 6,300 | Rainbow trout..... | { *53,000 171,000 |
| Sunfish..... | 10,570 | Rock bass..... | 8,900 |
| Whitefish..... | { *30,610,000 †167,500,000 | Smallmouth black bass..... | 3,530 |
| | | Sunfish..... | 15,200 |
| | | Yellow perch..... | 900 |
| | | Texas: | |
| | | Catfish..... | 70,350 |
| | | Crappie..... | 5,904 |
| | | Largemouth black bass..... | 257,370 |
| | | Rock bass..... | 320 |
| | | Sunfish..... | 74,872 |

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS, ETC.—Continued.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings.]

UNITED STATES AND TERRITORIES—Continued.

| State and species. | Number. | State and species. | Number. |
|----------------------------|----------------|------------------------------|---------------|
| Utah: | | Washington—Continued. | |
| Blackspotted trout..... | 91,300 | Sockeye salmon..... | { † 8,000,000 |
| Brook trout..... | 188,300 | | 3,457,000 |
| Catfish..... | 2,250 | | * 49,000 |
| Lake trout..... | *50,000 | Steelhead salmon..... | { † 15,000 |
| Rainbow trout..... | 161,000 | | 1,603,550 |
| Whitefish..... | †100,000 | West Virginia: | |
| Vermont: | | Brook trout..... | 212,815 |
| Brook trout..... | { †591,400 | Catfish..... | 8,100 |
| | 89,200 | Crappie..... | 2,700 |
| Lake trout..... | { *25,000 | Largemouth black bass..... | { † 6,000 |
| | †38,300 | | 8,212 |
| Landlocked salmon..... | { 4,900 | Rainbow trout..... | 181,100 |
| | *20,000 | Rock bass..... | 175 |
| Pike perch..... | { 6,000 | Smallmouth black bass..... | { † 12,000 |
| | *14,700,000 | | 750 |
| Rainbow trout..... | { †13,150,000 | Sunfish..... | 3,400 |
| | 7,200 | Yellow perch..... | 800 |
| Steelhead salmon..... | { *25,000 | Wisconsin: | |
| | 6,320 | Brook trout..... | { † 103,000 |
| Yellow perch..... | { *12,000,000 | Buffalofish..... | 655,355 |
| | †2,600,000 | Carp..... | 799,520 |
| Virginia: | | Catfish..... | 2,009,104 |
| Brook trout..... | 118,350 | Crappie..... | 18,580,500 |
| Catfish..... | 1,300 | Drum..... | 14,470,840 |
| Crappie..... | 160 | | 11,960 |
| Largemouth black bass..... | { † 15,000 | Lake trout..... | { † 512,000 |
| | 21,063 | | 15,000 |
| Pike perch..... | { † 500,000 | Largemouth black bass..... | 171,990 |
| Rainbow trout..... | 279,600 | Pike and pickerel..... | 322,130 |
| Rock bass..... | 10,660 | Pike perch..... | { † 5,000,000 |
| Shad..... | { † 6,452,925 | | † 29,000 |
| | † 88,500 | Rainbow trout..... | 150,190 |
| Smallmouth black bass..... | { 100 | Sunfish..... | 12,687,546 |
| | 8,225 | White bass..... | 6,620 |
| Sunfish..... | { † 74,113,600 | Whitefish..... | * 28,760,000 |
| Yellow perch..... | { 300 | Yellow perch..... | 1,012,230 |
| Washington: | | Miscellaneous fishes..... | 904,110 |
| Blackspotted trout..... | { * 100,000 | Wyoming: | |
| | † 9,000 | Blackspotted trout..... | { * 100,000 |
| Brook trout..... | { 79,700 | | † 2,044,900 |
| Chinook salmon..... | { * 300,000 | | 182,300 |
| | * 130,000 | Brook trout..... | { * 100,000 |
| Chum salmon..... | { 17,491,965 | | 302,400 |
| | † 7,000,000 | Catfish..... | 5,900 |
| Columbian salmon..... | { 19,436,400 | Lake trout..... | 20,150 |
| | * 75,000 | Largemouth black bass..... | 8,660 |
| Rainbow trout..... | { 3,000 | Loch Leven trout..... | 28,000 |
| | † 600,000 | Rainbow trout..... | { * 309,800 |
| Silver salmon..... | { 6,069,100 | | 327,000 |
| | | Smelt..... | * 200,000 |

FOREIGN COUNTRIES.

| Country and species. | Number. | Country and species. | Number. |
|-----------------------------------|--------------|----------------------------|----------|
| Canada: ¹ | | Mexico: | |
| Blackspotted trout..... | * 200,000 | Largemouth black bass..... | 600 |
| Rainbow trout..... | * 280,000 | Yellow perch..... | 500 |
| Whitefish..... | * 30,000,000 | Switzerland: | |
| France: Rainbow trout..... | * 150,000 | Lake trout..... | * 50,000 |
| | | Rainbow trout..... | * 50,000 |

¹ In exchange for trout eggs 600,000 Atlantic salmon eggs were received from Canada.

ASSIGNMENTS TO STATE FISH COMMISSIONS.

The following table shows the States in which the State fish commissions, as applicants, received part of the distribution shown in

the preceding table and gives the species and numbers of fish and fish eggs assigned to each such commission:

ASSIGNMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS, FISCAL YEAR 1921.

[NOTE.—Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings.]

| State and species. | Number. | State and species. | Number. |
|-----------------------------------|---------------|-------------------------------|---------------|
| California: Chinook salmon..... | * 3,000,000 | Nevada: Rainbow trout..... | * 50,000 |
| Colorado: Rainbow trout..... | * 50,000 | New Hampshire: | |
| Connecticut: Brook trout..... | 52,000 | Lake trout..... | * 25,000 |
| Idaho: | | Landlocked salmon..... | * 20,000 |
| Blackspotted trout..... | * 50,000 | Pike perch..... | * 2,000,000 |
| Landlocked salmon..... | * 15,000 | Whitefish..... | * 250,000 |
| Rainbow trout..... | * 50,000 | New Jersey: Pike perch..... | * 1,000,000 |
| Whitefish..... | 7,000 | New York: | |
| Illinois: | | Cisco..... | * 104,410,000 |
| Catfish..... | 25,300 | Lake trout..... | * 1,500,000 |
| Crappie..... | 5,800 | Landlocked salmon..... | * 100,000 |
| Drum..... | 175 | Steelhead salmon..... | * 199,000 |
| Largemouth black bass..... | 200 | Whitefish..... | * 29,200,000 |
| Pickerel..... | 410 | Ohio: Whitefish..... | * 23,640,000 |
| Pike perch..... | 250 | Oklahoma: | |
| Rock bass..... | 500 | Rainbow trout..... | * 100,000 |
| Sunfish..... | 26,325 | Rock bass..... | † 41,000 |
| White bass..... | 175 | Rock bass..... | 8,000 |
| Whitefish..... | * 500,000 | Rock bass..... | 100 |
| Iowa: | | Oregon: | |
| Lake trout..... | * 50,000 | Chinook salmon..... | * 3,650,000 |
| Rainbow trout..... | * 62,000 | Rainbow trout..... | * 604,940 |
| Maine: | | Pennsylvania: | |
| Lake trout..... | * 50,000 | Chinook salmon..... | 10,000 |
| Landlocked salmon..... | * 475,000 | Cisco..... | * 65,000,000 |
| Maryland: | | Lake trout..... | * 50,000 |
| Cisco..... | * 300,000 | Steelhead salmon..... | * 30,000 |
| Lake trout..... | * 4,000 | Whitefish..... | * 10,000,000 |
| Pike perch..... | * 1,000,000 | South Dakota: | |
| Rainbow trout..... | * 150,000 | Brook trout..... | 2,100 |
| Whitefish..... | * 100,000 | Rainbow trout..... | 3,000 |
| Massachusetts: Rainbow trout..... | * 50,000 | Tennessee: Rainbow trout..... | * 55,000 |
| Michigan: | | Utah: Lake trout..... | * 50,000 |
| Lake trout..... | * 1,000,000 | Vermont: | |
| Landlocked salmon..... | * 10,000 | Lake trout..... | * 25,000 |
| Pike perch..... | * 221,200,000 | Landlocked salmon..... | * 20,000 |
| Smelt..... | * 200,000 | Pike perch..... | * 14,700,000 |
| Whitefish..... | * 20,000,000 | Steelhead salmon..... | * 25,000 |
| Minnesota: | | Yellow perch..... | * 12,000,000 |
| Catfish..... | 6,800 | Washington: | |
| Crappie..... | 5,200 | Blackspotted trout..... | * 75,000 |
| Largemouth black bass..... | 9,310 | Rainbow trout..... | * 75,000 |
| Steelhead salmon..... | * 70,000 | Steelhead salmon..... | * 49,000 |
| Sunfish..... | 5,200 | Wyoming: | |
| Yellow perch..... | 2,250 | Blackspotted trout..... | * 100,000 |
| Missouri: | | Brook trout..... | * 100,000 |
| Rainbow trout..... | 100 | Catfish..... | 1,200 |
| Sunfish..... | 100 | Largemouth black bass..... | 2,150 |
| Montana: | | Rainbow trout..... | * 309,800 |
| Blackspotted trout..... | * 350,000 | Total..... | * 483,914,740 |
| Rainbow trout..... | * 150,000 | | † 41,000 |
| Steelhead salmon..... | * 75,000 | | 236,575 |
| Nebraska: | | | |
| Brook trout..... | 32,900 | | |
| Rainbow trout..... | 30,000 | | |

CONSIDERATIONS IN DISTRIBUTION OF COMMERCIAL FISHES.

The output of the bureau's hatcheries handling the commercial species is planted in local waters on the natural spawning grounds in so far as this may be desirable or practicable. This course is obviously necessary for the maintenance of the fishery involved, particularly where commercial fishing is aggressively prosecuted or where, as in the case of the anadromous fishes, commercial activities are coincident with the spawning season of the fish. It has been ably argued that the bureau's hatcheries belong to the people and that the output should be distributed more widely in neighbor-

ing States. If such a course were to be generally followed, the results would most certainly be disastrous. If a hatchery addressed to the propagation of a commercial species is successful in maintaining the fishery against the inroads of market fishing in the region covered by its activities, it may be fairly classed as efficient. If its annual output is only just sufficient to accomplish this purpose, it would be suicidal to divert any portion of it to other waters. Most of the States object, and with justice, through their fisheries authorities to the shipment outside their boundaries of eggs taken in their waters or the fry produced from such eggs.

The attitude of the fishermen is also a consideration. In most cases the bureau is to a large extent dependent on them for its egg collections. Speaking generally, the fishermen are deeply interested and render hearty cooperation. They watch the work with jealous interest, and any large or unwarranted diversion of eggs or fry would meet with strong opposition from them, and if persisted in would certainly result in refusal of the fishermen to deliver their eggs to the hatcheries. While the bureau's hatcheries are operated for the general good and the public is benefited by the increased food supply, the local fishermen are perhaps most intimately interested, and they should render every possible assistance to the hatcheries. Certain States now have laws whereby fishermen are given permits to fish during the closed season, with the restriction that all mature eggs shall be delivered to an agent of the bureau or the State for propagation. As the fishes are the property of the State, such a requirement is held to be just.

On the other hand, if a hatchery of the bureau succeeds in obtaining large numbers of eggs, more than are required for local waters, an intelligent distribution of the output to other waters is then permissible and even desirable. Under the most favorable conditions the results of natural spawning can not be expected to equal from 75 to 80 per cent of the numbers of young fishes put out by an efficient hatchery. Nature undoubtedly provides for a rather wide distribution of young fishes from natural reproduction. It is therefore not always advisable to limit the distribution of the output of a hatchery beyond reasonable restrictions, because if more young fishes are placed in a limited area than the waters can support they can not be expected to produce proportionate returns in marketable fish.

The following are among the points to be considered in connection with the distribution of the commercial species in new waters: (1) Do the waters under consideration support a commercial fishery? (2) Are the laws adequate for the protection of the fishes? (3) What are the conditions regarding dams or other barriers and pollution from trade or other forms of waste? (4) What is the attitude of local fishermen, and will they be willing to cooperate in the collection of eggs for the work of artificial propagation?

RESULTS OF PLANTING FISHES IN INTERIOR WATERS.

By E. C. FEARNOW,
Superintendent of Fish Distribution.

The question has frequently been asked whether the bureau's work in stocking streams and ponds in the interior States is producing satisfactory results. While the numerous letters received from ap-

plicants from time to time are favorable in character, no effort has heretofore been made to condense such information into a tabular form to indicate the general effects of the work.

The system of card-indexing applications, inaugurated in 1917, will in course of time give such information. However, it is believed that a table classifying the results accomplished during several years would be very useful in giving the bureau and the general public a concrete idea as to the value of the work that is being done in the interior States. A table of this character would also be invaluable when making assignments of fishes, as it would show what species are most productive in a given region.

The following is an explanation of the grades used in classifying the results: "Excellent" means that the fish increased in size and multiplied. "Good" is used where the applicant was satisfied, the fish attaining a large size, the number of fish apparently on the increase. "Fair" means that the results are only ordinary, many of the applicants merely use this word to express the results of the plants. "Overflow" is used where the dam of the pond broke and the fish escaped. This does not mean a loss of the fish, as in many instances the statement is made that certain streams were stocked by the breaking of dams. "Uncertain" is used where the applicant is undecided as to results. Most of the reports classified under this heading cover plants of fish made in large streams and lakes, where it was found difficult to determine whether the fish furnished by the bureau had actually produced results, owing to the waters being previously stocked with the same species. "Poor" covers reports which indicate that the plants were a failure. Failures are attributed to a number of causes as follows: Not adapted to the waters; fish received in poor condition; destroyed by snakes and other noxious animals. Many failures are attributed to the severe winter of 1916 and 1917, when ponds froze to an unprecedented depth. In some instances the fish were stolen.

The following table shows the general results of planting fishes during the fiscal year 1917:

GENERAL RESULTS, BY SPECIES, OF FISH PLANTINGS, FISCAL YEAR 1917.

| Species. | Number of reports. | Increase and growth. | | | | | |
|----------------------------|--------------------|----------------------|-------|-------|-----------|------------|-------|
| | | Excellent. | Good. | Fair. | Overflow. | Uncertain. | Poor. |
| Catfish..... | 127 | 34 | 47 | 25 | 2 | 8 | 11 |
| Buffalofish..... | 2 | 1 | 1 | | | | |
| Shad..... | 1 | | | | | 1 | |
| Whitefish..... | 4 | 2 | 2 | | | | |
| Steelhead salmon..... | 20 | 3 | 6 | 2 | | 8 | 1 |
| Landlocked salmon..... | 28 | 8 | 15 | 3 | | 1 | 1 |
| Rainbow trout..... | 589 | 157 | 224 | 98 | 7 | 50 | 53 |
| Blackspotted trout..... | 288 | 101 | 151 | 26 | | 6 | 4 |
| Loch Leven trout..... | 6 | 2 | 3 | | | 1 | |
| Brown trout..... | 1 | 1 | | | | | |
| Lake trout..... | 21 | 4 | | 2 | | | 3 |
| Brook trout..... | 1,514 | 532 | 717 | 124 | 6 | 45 | 90 |
| Grayling..... | 9 | 5 | 2 | 1 | | 1 | |
| Smelt..... | 3 | | 3 | | | | |
| Crappie..... | 235 | 59 | 77 | 49 | 9 | 20 | 21 |
| Largemouth black bass..... | 927 | 270 | 415 | 108 | 32 | 52 | 50 |
| Smallmouth black bass..... | 326 | 101 | 131 | 41 | 5 | 29 | 19 |
| Rock bass..... | 76 | 14 | 21 | 19 | 4 | 9 | 9 |
| Sunfish..... | 280 | 57 | 88 | 59 | 25 | 18 | 33 |
| Pike perch..... | 97 | 43 | 19 | 11 | 1 | 14 | 9 |
| Yellow perch..... | 32 | 10 | 8 | 4 | | 4 | 6 |
| White perch..... | 11 | | 2 | 1 | | 7 | 1 |
| Total..... | 4,597 | 1,402 | 1,943 | 574 | 92 | 277 | 309 |

Of the 4,597 reports received 30.5 per cent showed excellent results, 42.2 per cent good, 12.4 per cent fair, a little over 2 per cent overflow, over 6 per cent uncertain, and 6.5 per cent poor.

Black bass and sunfish appear to produce highly satisfactory results in most of the States, though many applicants have been dissatisfied with the sunfish on account of its small size, the growth attained not being as large as with some species. The stock of sunfish at most of the bureau's hatcheries has been improved in recent years, and it is believed that from now on this fish will give perfect satisfaction.

The rainbow trout appears to be especially well adapted to the waters of California, Colorado, New Mexico, Montana, North Carolina, and Wisconsin, while on the other hand a large percentage of failures or of only fairly good returns have been reported with that species in Arizona, Massachusetts, Ohio, New York, and Pennsylvania. This tends to accentuate the frequently expressed opinion that the rainbow trout is not as a rule adapted to eastern waters. It is true that the rainbow trout appears to have been very successfully established in West Virginia and in certain sections of Tennessee and North Carolina, but the data at hand would indicate that for eastern waters in general the conditions are better adapted to the brook trout. Numerous reports have been received to the effect that no rainbow trout were ever seen in waters where they had been planted. Mention of this failure of the rainbow trout to establish itself in certain sections of the country is very prominent in the reports.

DISTRIBUTION COSTS AND EQUIPMENT.

COST OF DISTRIBUTION.

As in all other lines of activity, the cost of distributing the output of the bureau's hatcheries has increased very considerably in recent years. The net increase in distribution costs since 1916 has amounted to approximately 150 per cent. The distribution of an output not appreciably decreased during this period, with no increase in funds provided for the conduct of the work, has been accomplished only by exercising the most rigid economy at every point. Unless additional funds for the propagation and distribution of food fishes is forthcoming, it may be necessary to inaugurate decided changes in the distribution methods to meet the increasing demands for fish.

During the fiscal year 1921 the cars of the bureau traveled 85,060 miles, while detached messengers in charge of live fishes traveled 385,988 miles, honoring approximately 10,000 applications for fish. The total cost of making this distribution, including maintenance and repairs to five distribution cars, amounted to \$69,600.

DISTRIBUTION CARS.

The two steel cars added to the distribution service during the spring of 1920 have fully demonstrated their superiority over the cars of wood construction. Their increased carrying capacity, together with lower cost for maintenance and repair, make them in every respect a high-class investment. It is recommended that the

two wooden cars still in use be replaced with cars of steel at an early date. In addition to the advantages already cited, it is frequently necessary to accept second-class service in the movement of the wooden cars, as many railroads refuse to move them in their first-class trains.

POCKET THERMOMETER FOR USE IN CARRYING LIVE FISH.

An improved device of interest in connection with the distribution of live fish is a pocket thermometer designed especially for the convenience of messengers in making shipments of fish or fish eggs. The column of mercury is protected by a hard rubber jacket, provided with a pocket clip and a ring, to which a cord may be attached. The advantages claimed for it over the type of thermometer previously used are its lighter weight and its greater convenience when in actual use. It is also less subject to breakage than the metal-jacketed thermometer.

Procedure in Assignments of Fishes to Applicants.

APPLICATION BLANKS.

On receipt of a request for fish the bureau supplies a blank calling for a complete description of the waters to be stocked. When the blank is properly executed and returned with the indorsement of a Member of Congress, the bureau endeavors to assign a suitable species of fish thereon, and the delivery is made at the earliest practicable date, at the applicant's railroad station, without cost to him. As the information requested on the application blank is used as a basis for determining the species to be assigned and to some extent the number of fish that will be furnished, the applicant should endeavor to have it as complete and accurate as possible.

SELECTION OF SPECIES.

One of the most perplexing problems confronting the division of fish culture is how to distribute the product of its hatcheries in a manner which will bring about the best results and at the same time be just and equitable to the large number of persons who every year apply to the bureau for fishes for stocking waters, both public and private.

Many persons who are familiar with some particular species of fish insist on its introduction into waters in which they may be interested. In one case an applicant who has recently moved to a new section of the country wants his favorite fish in the local waters, while in another case an applicant applies for a certain species on

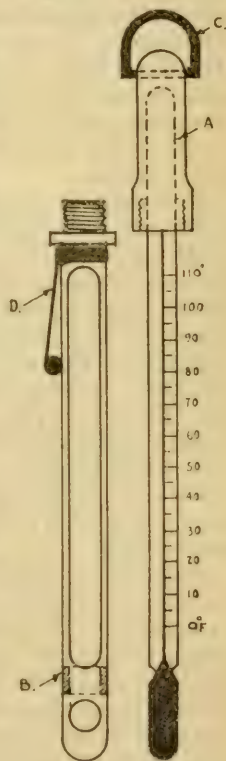


FIG. 5.—Pocket thermometer designed particularly for use in connection with the distribution of living fishes. (Designed by E. C. Fearnow.)

the recommendation of a friend or because the species has afforded him pleasure in another region. The importance of making a careful survey of the waters to be stocked, with the view of determining the species best adapted thereto, is often not recognized. It has been proved beyond a doubt that in nearly every case it is advisable to plant a species which is native to the locality, and in specifying his choice of fish the applicant should bear this in mind. Nonindigenous species should not be introduced unless it can be clearly shown that the native species, because of changed conditions, have failed to maintain themselves. There are many notable examples of the successful transplanting of fishes where the results have been highly beneficial. However, there is always an element of uncertainty in the planting of nonindigenous fishes in any region, and it should be undertaken only after a careful consideration of all phases of the situation, because if promiscuous plantings were to be permitted the work of fish culture might easily become a curse instead of a blessing to mankind.

The carp is an appropriate example of the results of the indiscriminate introduction of a foreign species. This fish was popular in the early history of fish culture in America, largely, perhaps, because it was a favorite with European fish-culturists and because of its rapid growth and ready adaptability to new surroundings. Through carelessness and indifference the carp became widely distributed in the waters of the country, with the result that in many sections a stigma will always apply to this sturdy fish. Nevertheless, there is a place in the piscatorial world for the carp, and for certain waters it fills a demand that can not be adequately met by any other species. It frequently happens that carp can be successfully and profitably propagated in waters that are quite unsuited to the finer species; and, under proper restrictions, this idea should be encouraged.

Aside from possible injury to indigenous species that may follow the introduction of foreign fishes, there are other important points to consider: Will the new inhabitants find a suitable temperature range and other conditions congenial to their reproduction? Will the food supply be of a suitable character and ample for their needs? Unless these essentials are present an introduced species can not establish itself in a new environment on a self-maintaining basis. Not infrequently species of fishes that are possessed of the highest food and game qualities in their natural habitat will, when transplanted in less favorable surroundings, degenerate to a point where they have no attractions either from a food or a game standpoint. Even the planting together of the same species of fish taken from different sections of the country or from different streams in the same section may be inadvisable. Certain investigators have expressed the belief that such plantings may lead, or in certain instances may have already led, to a form of hybridization which may result in seriously impairing the virility of the progeny.

Many of the more progressive State fish and game commissions have requested that all applications for certain species of nonindigenous or predacious fishes be submitted to them for approval. The bureau commends this policy, and all such applications, including those for carp, are referred before acceptance for the proper State

authorities to pass upon. Even with the State's indorsement the bureau reserves the right to exercise its judgment.

In connection with this matter, it appears expedient to continue the policy of refusing to supply the spiny-rayed fishes to applicants in the Pacific coast watershed. This step is essential for the protection of the important salmon and trout fisheries. The planting of the spiny-rayed fishes in the streams of the west coast might result in destroying millions of young salmon inhabiting such waters. The bureau maintains that the interests of the commercial fisheries are paramount to those of the sportsmen.

Eggs of certain species are furnished to State hatcheries where such a course appears to be to the interest of the work and, on rare occasions, to applicants having hatching facilities in cases where the eggs can be delivered more economically than the young fish.

SIZE OF ALLOTMENTS.

In determining the size of allotments of fishes on applications, the bureau is governed by the number and size of the requested species available for distribution in connection with the number of applications received for it, by the extent of water area to be stocked, and by the distance to which the fishes must be transported. It aims in every case to supply only a sufficient number of young fish for a brood stock, and the recipient is expected to provide for their protection until they have had time to mature and stock the waters through natural reproduction. The importance of adequate protection for fish furnished for stocking any body of water is so obvious that the bureau has seriously considered the advisability of curtailing or entirely discontinued the distribution of fish in localities where such protection is not afforded.

It is recognized that the larger bodies of water should receive the larger number of fishes for stocking purposes, but it does not appear judicious to honor applications for such waters to the exclusion of the smaller, though perhaps no less important, bodies of water. It is the policy of the bureau to apportion the output of its hatcheries in such a manner as will permit of filling all applications, so far as such a course may be practicable. Applications are frequently received from persons in sections remote from a fish-cultural station and in a part of the country where it is known that the waters are already abundantly stocked with desirable species. In such instances the bureau does not consider it wise to incur the expense of sending small numbers of artificially reared fishes to a considerable distance, and the applicants are so notified.

TIME AND METHOD OF DELIVERY.

Certain species, notably the brook trout and the rainbow trout, are planted whenever possible during the fingerling stage; but, as the rearing facilities are limited, the stock must be reduced in the early spring to prevent overcrowding. Thus, a part of the output is annually shipped in the fry stage. The distribution of the basses and other pond fishes begins about three weeks after they are hatched and extends over a period of several months, the last lots of fishes sent out ranging from 2 to 4 inches in length. The basses, sunfishes,

crappies, yellow perch, and other fishes rescued from landlocked ponds and pools in the Mississippi River Valley are from 3 to 6 inches long when distributed.

It is the policy of the bureau to fill applications in the order of their receipt and to deliver fishes assigned as soon thereafter as possible, but there are certain conditions connected with the distribution work which should be thoroughly understood by prospective applicants.

The cost involved in making shipments of fishes compels the bureau to exercise the utmost economy in arranging its distribution work. The delivery of special consignments and those intended for distant points must be delayed until a sufficient number of applications from the same section of the country have been received to warrant the expense of a messenger shipment. The bureau can not carry a stock of fish for delivery on demand, and when the supply of one year is exhausted no more are available until the crop of the succeeding year is ready to be sent out. The shipment of trout from the bureau's eastern stations begins early in March, and all applications received after that time are carried over until the following year. Trout distributions from stations in the Rocky Mountain regions are made between May and October, and, in order to insure early attention, applications from that part of the country should be in the Washington office of the bureau not later than May 1. The so-called warm-water fishes, including black basses, sunfish, and crappies, are shipped between May and December, and requests for them should be submitted prior to May 1.

The fishes are shipped in railroad cars especially designed for the purpose or in baggage cars, accompanied by a messenger, and the delivery is made at the applicant's railroad station without expense to him. When an application for fish is received by the bureau the person submitting it is immediately notified of the species assigned thereon and the approximate time when delivery may be expected. Full directions for the reception and care of the fish are also sent to him. Prior to the shipment a second notice is sent, usually a telegram, specifying the exact time when the assignment will arrive at his railroad station. If for some unforeseen reason it becomes necessary to postpone the delivery, the applicant is notified accordingly.



MBL/WHOI LIBRARY



WH LAIW 0

